STAKEHOLDER PERSPECTIVES ON WASTE AND APPROPRIATE WASTE AND MATERIALS MANAGEMENT IN NEW YORK STATE

A Thesis

Presented to the Faculty of the Graduate School

of Cornell University

In Partial Fulfillment of the Requirements for the Degree of

Master of Arts

by

Micah John Baclig

August 2019

ABSTRACT

This study explores the state of waste and materials management in New York State by gathering and analyzing stakeholder perspectives on appropriate solid waste management. Participants were 21 individuals from county governments, private waste companies, and local community reuse organizations. Perspectives were primarily collected through an activity called conceptual content cognitive mapping (3CM), a quantitative and qualitative methodology that is based on cognitive mapping literature and allows for commonalities and differences in perspectives to be identified and analyzed. Perspectives were coded and analyzed using methods including descriptive statistics, hierarchical cluster analysis, thematic analysis, and frequency analysis. Analyses also included between-groups comparisons (e.g., by stakeholder group, participation in pro-environmental behaviors (PEB), demographic groups). Results indicate a wide range of items, topics, and themes that were identified as important focal points by waste management stakeholders with consensus on a few key areas including: importance of education, source reduction, extended producer responsibility, strategic partnerships, and operations. Implications for the study of waste within the field of environment and behavior are discussed.

BIOGRAPHICAL SKETCH

Micah Baclig grew up in Kailua, Hawaii. Before Cornell University, Micah attended the Rhode Island School of Design, where he received his B.F.A. in industrial design, and worked in Providence, Rhode Island as a designer and teaching artist. At Cornell, Micah pursued a degree in sustainable design studies from the Department of Design and Environmental Analysis in the College of Human Ecology. Micah credits his passion for sustainability and environmental justice to three sources:

- A required, undergraduate seminar on manufacturing techniques which taught him that the number of techniques to create (and dispose of) a product far exceeds the number of techniques to meaningfully reuse or remake that same product
- A passage by Victor Papanek in *Design for the Real World* that states "we must stop defiling the earth itself with poorly-designed objects and structures"
- His older brother, Antonio, who has devoted his career to addressing climate change by researching renewable energy and energy storage.

ACKNOWLEDGMENTS

I am deeply grateful for all the support, mentorship, and guidance given to me during this project. First, I am immensely thankful for and inspired by my advisor, Professor Nancy Wells, who was unwavering in her support and guidance of me during this extended process – thank you so much. I am also thankful to my minor member, Professor Tasha Lewis. Thank you for always providing me with your unique perspective and for always exuding a warm and cheerful energy. I must also thank Stephen Parry of the Cornell Statistical Consulting Unit for his statistical consulting; I so appreciate your generosity and thoughtfulness. Lastly, I wanted to thank all of the participants of my study for graciously giving me their time and their perspectives. I am so moved and energized by your work.

Finally, I'd like to thank my friends and family, both near and far. Thank you to the students, faculty, and staff of the Design and Environmental Analysis department. Thank you as well to the many friends who supported me throughout this process (you know who you are). Thank you to my Pinoy family in Ithaca, particularly Tito Dito and Tita Thess. And thank you to my family—Dad, Mom, Ton, Trishna, Leela, and Vanessa.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

3CM – Conceptual Content Cognitive Mapping

C&D – Construction and Demolition Debris

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CWA– Clean Water Act

DEC – Department of Environmental Conservation

EPA – U.S. Environmental Protection Agency

EPR – Extended Producer Responsibility

E-Waste – Electronic Waste

ICI – Industrial, Commercial, and Institutional sources

ISW – Industrial Solid Waste

LCA – Life Cycle Assessment

MMT CO2 Eq. – Million Metric Tons of CO_2 Equivalent

MRF – Material Recovery Facility (pronounced "Murph")

MSW – Municipal Solid Waste

PAYT – Pay as You Throw

PEB – Pro-environmental Behavior

RCRA – Resource Conservation and Recovery Act

SMM – Sustainable Materials Management

SWDA – Solid Waste Disposal Act

WTE – Waste to Energy

CHAPTER 1

Introduction

Waste is a patently wicked planning problem in that there are countless ways its causes and effects on humans and the environment can be defined and subsequently addressed (Rittel & Webber, 1973). For example, a popular statistic estimates that Americans generated 4.4 pounds of Municipal Solid Waste (MSW) per person per day in 2014 (U.S. Environmental Protection Agency [EPA], 2016). This figure has been used as an indictment of U.S. waste production as well as individual consumption habits and, consequently, as a catalyst for changing the status quo (Loki, 2016; D'Souza, 2018; Leahy, 2018). However, the figure is easily complicated and not a tidy explainer.

First, the MSW per person per day statistic represents the total amount of MSW generated before portions are diverted through other means (e.g. recycling, compost, waste to energy). After these other streams were accounted for, Americans ultimately sent 2.3 pounds of MSW per person per day to landfills in 2014 (EPA, 2016). Second, MSW, a category of waste characterized by the U.S. Environmental Protection Agency (EPA) as comprising "packaging, food, yard trimmings, furniture, electronics, tires, and appliances" (EPA, 2016, p. 4), encompasses residential, commercial, and institutional sources within its scope, calling into question an individual's agency in affecting this total (Liboiron, 2014). One might argue that these complications could be resolved with more careful reporting (MacBride, 2013) or, perhaps, that they are deliberate—presented in such a way as to achieve maximum motivational impact. However, other complexities, like the *evolving ton*, growing discord over weight-based metrics, and the question of scalar priorities, are harder to parse; next, we will consider these intricacies to further illustrate aspects of wicked planning problems. Thereafter, we argue that the wicked

planning problem concept provides planners and researchers a necessary framework for approaching their work.

In recent years, the waste management and recycling industries have been grappling with the phenomenon known as the "evolving ton," which is the changing material nature and overall composition of the waste stream (Elliot, 2015; Miller, 2017). There are many factors contributing to the changing waste stream. For example, innovation in consumer packaging has led to lighter packaging designs on all material fronts (e.g., glass, metals, plastics) as well as a substantial rise in lightweight, flexible, and multi-layered packaging (Miller, 2017; Workman, 2018). The rise in e-commerce shopping has also contributed to this development by dramatically increasing the amount of corrugated cardboard and flexible packaging flowing through waste and recycling streams (Miller, 2017).

Waste management and recycling professionals are already dealing with the consequences of the evolving ton phenomenon. For example, material recovery facilities (MRFs) have had to expend greater resources to collect a ton of a given recyclable material. For MRFs collecting aluminum used beverage cans, "it used to take 28 aluminum cans to make a pound; today, it takes about 34 to 36 to reach a pound" (Workman, 2018, para. 17). Notably, the evolving ton also precipitates important questions regarding the usefulness of weight-based metrics. If the MSW stream is constantly changing, how useful is it to compare longitudinal weight-based statistics, on an aggregate or even per capita basis? In other words, if a 2014 ton of MSW has a different material composition than its 2004 counterpart, are the two really comparable? Shouldn't the analyses and subsequent considerations of the environmental and social impact of those two tons be different as well?

Complications arising from the evolving ton are echoed in a recent push by stakeholders in public and private waste management to shift from weight-based diversion metrics to impact-based ones (Leif, 2017). A major reason for proposed change is the lack of consistency in how local, state, and national bodies calculate and report their materials recycling and recovery rates. Moore, B. and Engel (2016) found significant discrepancies in how cities and states considered their MSW data, particularly with respect to how they treated industrial, commercial, and institutional (ICI) sources in their calculations and whether they relied on actual reported tonnages versus estimates (Moore, B. & Engel, 2016). Another reason for change is the growing realization that certain popular diversion techniques do not always correlate with the lowest-impact option for humans or the environment. A report by the Oregon Department of Environmental Quality found mixed results as to whether the material attributes of recyclability, use of recycled content, use of biobased content, and compostability in packaging and foodservice items always resulted in the lowest impact option (Lief, 2019a; Vendries et al., 2018). For example, in their analysis of recyclable packaging, Vendries et al. found "that packaging weight and material type considerations are a better predictor of environmental impacts than the attribute of recyclability" (Vendries et al., 2018, p. 52).

Finally, many question the amount of resources being devoted to researching MSW over other waste streams (Leonard, 2010; MacBride, 2012b). The best estimates available indicate that MSW makes up 2.5% of total US waste generation by tonnage in a given year. By comparison, Industrial Solid Waste (ISW), or waste produced by a range of industrial activities like agriculture, energy production, and manufacturing (MacBride, 2012a), makes up to 76% of that total (Leonard, 2010, Chapter 5; Liboiron, 2014). Why bring attention to per capita MSW

rates—particularly the individual's ability to affect MSW rates through their behaviors—when MSW is responsible for such a small fraction of total US waste production?

Waste's ability to evade a straight forward problem-solution articulation is a hallmark of "wicked" planning problems (Rittel & Webber, 1973). As Rittel and Webber (1973) contend, there can be no absolute formulation of a wicked problem:

> The formulation of a wicked problem *is* the problem! The process of formulating the problem and of conceiving a solution (or re-solution) are identical, since every specification of the problem is a specification of the direction in which a treatment is considered. (p. 161)

From one perspective, the aforementioned per capita statistic represents a problem of individual waste generation within the United States thereby suggesting treatments oriented around reducing that amount. From another perspective, the 4.4 lbs per person per day figure represents a failure to appropriately and consistently measure the impacts of waste, justifying solutions framed around developing more transparent and unified waste-impact methodologies. From a third perspective, the figure and continued focus on MSW represents a deliberate strategy to shift the responsibility of disposal away from corporations and onto the individual, begetting a range of possible solutions related to resisting neoliberal policymaking and promoting producer responsibility laws.

These viewpoints demonstrate that definitions of and solutions to wicked problems are not true or false (since they are innumerable), but rather good or bad depending on the parties in question and their specific concerns and ideologies (Rittel & Webber, 1973, p. 163). Planning, therefore, should be an argumentative process where the parties involved collaboratively and critically develop an idea of the problem-solution dyad (Rittel & Webber, 1973, p. 162). Liboiron (2013), writing about ocean plastics pollution, identifies the moral imperative that the work of addressing (and defining) wicked problems presupposes:

> . . . they imply an ethics of defining wicked problems. Such problems, characterized by complexity and open systems made up of material and social elements, must be recognized as such, and this recognition must be carried into efforts to define them. Thus, defining a problem and deciding where to draw boundaries concerning what is and is not part of the problem have effects in the world outside of the planning room, regardless of proposed solutions. Because of these effects, being in a position to define problems one way and not another is a form of power. (p. 6)

This embedded imperative reinforces an important responsibility for those who attempt to address wicked planning problems, and, in relation to this paper, wicked waste problems. Planners, researchers and waste management professionals, should not be discouraged by the potential vastness of wicked problems, but rather emboldened to not only consider whether their solutions are socially and environmentally just, but also to reflexively evaluate the content and validity of their problem definitions.

The broad objective of this thesis is to explore the wicked nature of waste—an issue of increasing environmental and social consequence—alongside the many ways the field of waste management has endeavored to address it. Although waste and materials management encompasses a wide array of disciplines and fields, this paper draws its theoretical perspective and methodological approach from the field of environmental psychology. Gifford (2014) defines environmental psychology as "theory, research, and practice aimed at improving human relations with the natural environment and making the built environment more humane" (p. 543). Given this understanding, the study of waste and materials management within environmental psychology and environment and behavior research often centers around the individual and the various factors associated with an individual's waste-related knowledge, values and behaviors. An identified challenge of this thesis is rectifying environment psychology's stated emphasis on the individual and a small range of codified waste-related behaviors with a waste system that has been demonstrated to be incredibly complex and dynamic.

In the subsequent sections of this chapter, we outline the consequences of waste on humans and the environment, briefly chart progress that has been made in the 21st century, and highlight key challenges that remain. Finally, we propose a new framework for studying waste and materials management within the field of environment and behavior. This new framework influenced the primary research questions and methodological approach of the field research presented later in this paper.

Consequences of Waste

Waste is a crucial environmental and social issue for the 21st century. A stated focus on solid waste and the effects of solid waste management is necessary since the term 'waste' can describe a wide range of states (e.g., solid, liquid, gas, thermal) and definitions (e.g., MSW, ISW, pharmaceutical waste). Admittedly, even "solid waste" is a broad classification; this study will mostly address MSW, construction and demolition (C&D) waste, and some forms of ISW and hazardous waste. The United States and New York state are the primary contexts for this study although issues of waste and waste management are increasingly non-local and global. Though an exhaustive review of the effects of waste is beyond the scope of this thesis, we briefly consider how the consequences of society's solid waste issues have been conceptualized, defined, and quantified under the following schemes: sanitation, human health, the environment, social issues, politics and economies. Below, "sanitation" outlines how waste and waste management have been conceptualized to affect sanitation and human health.

Sanitation. The association between sanitation, human health, and waste coalesced in Western Europe and the United States during the sanitary reform movement of the late 19th century. In the late 1800's, the rapid growth of European and American cities led to dire accumulations of filth and garbage in city streets and common spaces. The popular, and now-

debunked, miasma theory of disease linked the spread of infectious diseases (e.g., cholera, yellow fever) with these dirty environmental buildups via the diffusion of their noxious odors (Nikolova, 2012). In London and then in other cities, the concept of sanitation and the field of public health emerged as a means for addressing these epidemics and their perceived causes. Cities and smaller municipalities began to develop sanitation policies and infrastructure by "paving streets, building sewers, providing clean water, establishing ventilation, reducing crowding in housing, and hauling away garbage" (Nikolova, 2012, p. 541). Although the miasma theory misidentified fumes and odors as the root cause for the spread of disease, the new sanitation practices did correlate with better health outcomes for reasons related to bacteriology and vector-borne diseases that would later be discovered. Eventually, the miasma theory of disease was supplanted by germ theory as an explanation for the spread of infectious diseases, but sanitation practices like street cleaning, waste hauling and waste management remained codified in public consciousness and city infrastructure as necessary and remedial social services.

Human health. Today, the effects of solid waste on human health can be outlined by addressing five topics: the dangers of open dump scenarios, the increasingly synthetic and toxic nature of modern materials, the history of two primary solid waste management practices (i.e., landfilling and incineration), and the occupational hazards associated with various forms of waste management. Below we describe each topic pertaining to the effects of solid waste on human health.

Dangers of open dumps. In open dumps or other unchecked accumulations of waste, diseases can be spread to humans through contact with bacteria, disease vectors, and toxic substances (Grover, 2012). A breakout of the pneumonic plague in Surat, India in 1994 was

connected to improper waste management where uncollected wastes and animal carcasses were exposed to rain and flooding and subsequently contaminated grain supplies and attracted infected rodents (Swamy, Vyas, & Narang, 1994; Nzeadibe & Madu, 2012).

***Modern materials*.** The growing synthetic and heterogeneous nature of modern materials is another significant factor affecting human health and the health of our ecosystems (MacBride, 2012b, p. 174). There are about 100,000 synthetic compounds used in modern industrial production; although the impact of many of these compounds on humans and the environment is still unknown, exposure (e.g., inhalation, ingestion, direct contact) to some of these synthetic materials in certain doses have been found to be toxic (Leonard, 2010, Chapter 2). Endocrine disrupting compounds, like bisphenol A, are well-known synthetic compounds that interact with the human hormone system and can result in negative health outcomes like infertility and heart disease (Liboiron, 2017). The lifespan of synthetic materials is another consideration as these compounds (e.g., many plastics) may take centuries to break down (Andrady, 2015).

Industrial solid waste – byproducts of our modern material society – must be noted due to the far greater quantities of industrial waste that are generated over MSW. Industrial waste is defined broadly as byproducts arising from "mining, petroleum extraction and refining, agriculture, energy production, construction and demolition, transportation, or manufacturing activities" that are emitted into the atmosphere, waterways, or ground[1] (MacBride, 2012a, p.429). Although many developed countries define industrial waste differently, its definition always excludes MSW and nuclear waste (MacBride, 2012a). A portion of industrial waste can be further classified as hazardous waste when it has been empirically proven to be dangerous to

[1] This paper's focus on solid waste precludes further investigation into other forms of waste (e.g., liquid, gas) and related topics like wastewater treatment.

health and safety. However, this process of classification is heavily contested by different stakeholder groups (e.g., industry, citizens groups) (MacBride, 2012a).

Landfilling. The practice of landfilling and its development over the course of the 20th century provide a third key profile of the effects of solid waste and solid waste management on human health. To account for the disease-spreading factors and the changing material nature of waste, sanitary landfills were developed as early as the 1920's and 1930's (Weber, 2012). These improved landfills implemented methods for waste hauling, tipping, and compacting. Sanitary landfills also began the practice of regularly covering layers of waste with *daily cover*, or layers of soil, ash, or other fill material that was meant to reduce odors and loose litter from escaping the landfill and to prevent vermin or other creatures from entering (Weber, 2012).

Even in sanitary landfills, however, solid waste can affect human health in numerous ways. First, particulate matter from landfill cover, loose waste, and emissions from landfill machinery (e.g. transportation vehicles, compactors) affects the respiratory health of those in close proximity to landfill sites (Grover, 2012). Second, the decomposition of organic material in landfills creates methane (CH_4) and other gases[2] that are poisonous and can cause explosions in uncontrolled settings or closed landfills that are not properly maintained (Massen, 2012). Third, depending on the composition of waste in a landfill and the permeability of the soil where the landfill is sited, solid waste can pollute surface and groundwater and potentially contaminate water supplies, soils, and crops. This pollution can cause health hazards via ingestion, exposure or direct contact (Grover, 2012; Nathanson, 2015). Leachate, a highly toxic slurry that results

[2] Methane and other gas emissions associated with solid waste management and their combined contribution to global warming are discussed in the next section, "The environment."

from the exposure of waste to precipitation, poses a significant health risk when it reaches and pollutes groundwater supplies or other bodies of water (Nathanson, 2015).

In the latter half of the 20th century, the failings of the sanitary landfill and the numerous health risks still associated with solid waste management were recognized in the United States during the environmental movement of the 1960's. The Solid Waste Disposal Act (SWDA) of 1965 allotted federal funding for states and municipalities to conduct research on the local waste problems. The Resource Conservation and Recovery Act (RCRA) of 1976 and later amendments were the result of this research and established regulations around the management of solid and hazardous waste (Hunsaker-Clark, 2012).

As a result of the RCRA and subsequent regulations, a number of additional precautionary practices are now enforced in modern, sanitary landfills to address the effects of solid waste outlined above. Completed landfills are covered with a layer of clay, topsoil, and vegetation while new landfills are required to be bottom-lined with plastic or mineral liner to prevent waste from interacting with water supplies and soil (Weber, 2012; Nathanson, 2015). Following RCRA, landfills are also required to collect methane and other gases through a network of pipes that are embedded within landfill layers. This collected gas is either treated, used for electricity generation, or flared off (Reno, 2012). In a similar way, landfills are mandated to include leachate drainage, collection, and treatment systems to reduce leachate formation and prevent further water and soil pollution (Weber, 2012).

Regarding the landfilling of solid industrial waste, hazardous waste is heavily regulated from point of origin until disposal. Permitting is required to landfill hazardous industrial solid waste in specialized facilities, separate from landfills that receive MSW and C&D in order to reduce their comingling (Vergara, 2012; Nathanson, 2015). The disposal of nonhazardous

industrial solid waste is less regulated and is often kept onsite at industrial properties or landfilled with MSW and C&D (MacBride, 2012a).

Despite the additional precautions of the modern landfill, sanitary engineers recognize that they will never be able to anticipate with full certainty the ways that landfill waste might one day affect humans or the environment (Nathanson, 2015). Additional local, state, and federal resources are put toward creating aftercare plans for current landfills and for remediating closed landfill sites, areas of illegal dumping, and industrial waste sites which operated before many waste-treatment regulations existed or violated government law (Nathanson, 2015). The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as the Superfund program, is an example of a federal remediation program that treats these sites (Cusack, 2012).

Waste incineration. Waste incineration and its development over the course of the 20th century provides a fourth point for outlining the effects of solid waste on human health. Although the practice of burning garbage existed for centuries, large waste incinerators first appeared in America and Europe in the later 1800's (Vergara, 2012). Incineration at these sites and the in-house or backyard incineration of waste were common practices in the United State in the first half of the 20th century (Humes, 2010; Vergara, 2012). Incineration can be a popular form of waste management because the method drastically reduces solid waste's volume and weight; the method is also harnessed to produce electricity in certain scenarios, known as waste-to-energy (WTE) (Nathanson, 2017). However, emissions from these early incinerators and from the burning of waste in an uncontrolled manner are a serious health hazard (Vergara, 2012). Waste incineration, like other combustion processes, results in the production of gasses (e.g., CO_2), water, and other particulate matter (e.g., ash). Depending on the waste being burned plus a

variety of other factors, the process can produce numerous toxic emissions and particulates. Vergara (2012) reviews some of these potential byproducts:

> The sulfur in waste gets converted to SO_2, whose emission is implicated in the formation of acid rain. In the presence of high temperatures and oxygen, the nitrogen in waste gets converted to NOx, which plays a role in the production of ozone (O_3). Heavy metals in waste, such as mercury (Hg), lead (Pb), cadmium (Cd), and arsenic (As), also volatilize and condense onto fly ash particles; these metals are harmful to human and ecological health. Incineration of chlorine-containing fuel (such as plastics) can result in the emission of dioxins and furans (polychlorinated- dibenzofurans, and polychlorinated-dibenzodioxins), which are chlorinated hydrocarbons that are persistent, toxic, and bioaccumulating. (p. 414)

In the United States, incineration was similarly affected by the environmental movement of the 1960's and subsequent pollution-abatement laws. As a result, the practice of backyard or inhouse garbage burning is outlawed and modern incineration facilities require a number of air pollution control measures (e.g., scrubbers, fabric filters, cyclones) (Vergara, 2012). Despite these pollution abatement technologies and regulations, waste incineration is largely opposed in the United States, but it is widely used by countries in Europe and in Japan today (Vergara, 2012).

Occupational hazards. Finally, an overview of the domestic and international occupational hazards associated with solid waste management, is necessary in outlining the consequence of waste on human health. In 2017, solid waste and recyclables hauling had the fifth highest work fatality rate of U.S. civilian occupations, with a fatal injury rate of 35 per 100,000 full-time equivalent workers (U.S. Department of Labor, 2018a). In the same year, MRFs had the fourth worst rate of nonfatal workplace injuries and illnesses in the United States, with an incidence rate of 9.8 per 100 full-time equivalent workers (U.S. Department of Labor, 2018b). Although a majority of these fatalities and injuries were vehicular related, mirroring trends in other sectors, attention has shifted towards MRF working conditions as the previous report suggests injuries at MRFs increased by 60% in 2017 (Staub, 2018; Staub, 2019a).

In developing countries, occupational work hazards associated with solid waste management are exacerbated by a lack of infrastructure, regulation, and the movement of hazardous waste, particularly electronic waste (e-waste), from the global north to the global south (i.e., toxic colonialism). Many developing countries lack solid waste management infrastructure and regulation for a variety of reasons (e.g., lack of funding) and it is estimated that over one billion people are without appropriate waste management services (Nzeadibe & Madu, 2012). For many in these countries, scavenging and collecting discarded materials is a form of employment where there is otherwise a lack of meaningful work. However, these informal resource recovery and scrap industries lack proper infrastructure and regulation and, as a result, workers are exposed to dangerous work conditions. Gill (2016) outlines the ways in which workers handling e-waste can be exposed to health hazards:

> Processes such as dismantling components, wet chemical processing, and incineration are used and result in direct exposure and inhalation of harmful chemicals. Safety equipment such as gloves, face masks, and ventilation fans are virtually unknown, and workers often have little idea of what they are handling. (para. 3)

Long term exposure to these toxins and other harmful material under these working conditions can lead to cancer, neurological disorders, nervous system damage (Leonard, 2010; Gill, 2016).

Although international agreements like the Basel and Bamako Conventions were created and ratified to protect human health and the environment in developing countries from the transboundary movement of hazardous waste, the problem still exists (MacBride, 2012a). The illegal exporting of hazardous waste continues under the guise of industrial scrap trade, which is exempt from the Basel Convention, and cases have been documented for countries in Europe for plastics and the United State and Canada for e-waste (MacBride, 2012a). China's implementation of strict restrictions on imported scraps (e.g., industrial waste, electronics) and recyclables (e.g., plastics, paper) in late 2017, known as "National Sword" in the United States

(Paben, 2017), is of a recent effort by that country to reduce the negative effects of waste on its populace. Southeast Asian countries, like Malaysia and the Philippines, have moved to implement similar restrictions (Ives, 2019).

Environment. The negative effects of solid waste and solid waste management on the environment have been studied and documented in a variety of ways. This section outlines the ways solid waste and solid waste management affect the environment and its ecologies by polluting land masses, bodies of water, and air quality, and by contributing to global warming. The impact of waste as a proxy for the total environmental impact of society (i.e., extraction, manufacturing, consumption) (Hoornweg, Bhada-Tata, & Kennedy, 2014) is also discussed.

Land pollution. Solid waste pollutes land masses and water supplies via the dissemination of leachate from landfills and through the accumulation of synthetic and toxic materials. As previously discussed, leachate, which forms when toxic landfill waste mixes with precipitation, pollutes nearby soil and water supplies and affects surrounding food chains (Nzeadibe & Madu, 2012). In the same way that synthetic compounds have been shown to affect human health, they have also been shown to play a role in hormone disruption in both terrestrial and aquatic animals (Moore, C., 2017). Debris from landfills can prove dangerous as land birds and other animals that feed near waste dumps have been shown to have plastic in their stomachs (Moore, C., 2017).

Additionally, the large accumulation of toxic materials, like ISW and hazardous waste, negatively affect land and water ecologies. Coal ash, the byproduct from the coal burning process, is one prominent example. Coal ash is usually comprised of silicon dioxide (SiO_2), aluminum oxide ($A1_2O_3$), iron oxide (Fe_2O_3), and trace amounts other hazardous compounds (Trumpeter, 2012). Although methods to recycle coal ash exist (e.g., as an ingredient for

concrete), the majority of it is either disposed in landfills or kept in impoundment ponds (Trumpeter, 2012). In February 2014, 39,000 tons of coal ash and 27 million gallons of coal ash waste water spilled into North Carolina's Dan River from a Duke Energy facility, polluting waterways and threatening surrounding environments and human health.

Water pollution. Although many of the same sources pollute land masses and bodies of water, waterways and oceans are uniquely impacted by waste via point source pollution (e.g., ocean dumping, industrial activity) and nonpoint source pollution (e.g., marine plastics) (Church, 2012). For many coastal cities in the United States, ocean dumping was the primary method to dispose of municipal waste until the early 1900's. In 1934, the U.S. supreme court banned the dumping of municipal waste in the ocean, but the dumping of industrial, commercial, and military waste continued into the 1970's (Church, 2012).

The Clean Water Act (CWA) of 1972, and its subsequent revisions, regulates the dumping of waste and wastewater into U.S. waterways and water supplies by municipalities and industry (Holst, 2014). The CWA sets a minimum water quality standard for national waterways and requires industries to abide by a permit system and EPA guidelines for water quality (Holst, 2014). With the 2014 North Carolina coal ash spill, Duke Energy was fined $102 million for pleading guilty to criminal negligence in violating the CWA (Dewitt, 2015). Despite this case, many have called for revisions to the CWA because it does not give regulators enough power to prosecute polluters (Black, 2012). Nonpoint source pollution, or waste and pollution that originate from multiple and often unidentifiable sources, provide another challenge that is harder to regulate.

The accumulation of marine plastic pollution is a significant threat to our ocean ecologies and human health because of their near permanence (Geyer, Jambeck, & Law, 2017). Because

oceans are downstream from all other sources, it represents the biggest sink for society's plastic pollution problem (Liboiron, 2013; Moore, C., 2017). Marine plastics have been found in all major ocean basins (Barnes, Galgani, Thompson, & Barlaz, 2009) and massive amounts of plastic and other wastes enter oceans ever year. An estimated 4.8 to 12.7 million metric tons of plastic waste entered the ocean from coastal cities in 2010 (Jambeck et al., 2015). The Great Pacific Garbage Patch, a zone in the Pacific Ocean roughly the size of Texas, is a popular example of the ocean plastics problem (Bauer, 2015).

Plastic pollution affects ocean ecologies in numerous ways. Marine mammals can die from becoming entangled in plastics and other ocean debris, like discarded fishing nets (Moore, C., 2017). Ingestion is another significant threat; as research shows species of all kinds and sizes ingest plastic, microplastics, and other pieces of trash. For animals, these waste pieces can cause mechanical harm (e.g., choking, blockage) as well as chemical harm (e.g., poisoning) (Liboiron, 2013; Moore, C., 2017). The process of biomagnification can amplify these chemical problems up the food chain as successive iterations of predators consume their prey and subsequently absorb the toxins they were carrying (Liboiron, 2013, p.78).

Plastic's materiality and its propensity to leach and off-gas chemicals is another significant and perplexing concern for ocean ecosystems. Plasticizers, which are compounds added to plastics to give them a range of material properties (e.g., color, flexibility) are especially susceptible to off-gas or leach in the sunlight and under ocean conditions (Liboiron, 2013). As previously discussed, these compounds have been shown to cause a range of negative effects in humans and animals under certain conditions and with certain dosages. However, more research is needed as the causal link between these compounds and negative health outcomes is complicated by the growing understanding around the "cocktail effect" (i.e., the effect of

multiple chemicals mixed together in a system), low-dose theory, and toxicogenomics (Liboiron, 2013).

Air pollution. Air quality is another aspect of the environment affected by solid waste and its management. As previously discussed, landfilling and incineration are two main practices that affect the local air quality. Landfills generate local air pollution through the emissions of landfill machinery (e.g., landfill compactors), through the dispersal of particulate matter like dust and daily cover, and through the natural gasses that landfills generate and emit (Grover, 2012). Incinerators generate air emissions through the processes of combustion, pyrolysis and gasification (Vergara, 2012). Although both landfills and incinerators benefit from better containment technology and more regulation, pollution inevitably results (MacBride, p. 2, 2012b).

Global warming. Beyond contributing to local pollution, waste management also affects the environment broadly through the sector's greenhouse gas emissions that contribute to global warming. In 2016, landfills were the third largest component of anthropogenic methane emissions in the United States, emitting 4,306 kilotons of CH_4 into the atmosphere or 16.4 percent of all U.S. methane emissions (EPA, 2018b). Together with wastewater treatment and composting, the waste sector emitted 131.5 million metric tons (MMT) of CO_2 equivalent in 2016 (MMT CO2 eq), representing 2.0 percent of total U.S. greenhouse gas emissions in that year (EPA, 2018b). Waste incineration, considered in the same EPA report as part of the energy sector[3], contributed 11.0 MMT CO2 Eq. to U.S. emissions in 2016 (EPA, 2018b).

[3] Calculating emissions that result from incineration is complicated by the plurality of waste types that are incinerated for energy (i.e. fossil fuel derived waste, biogenic waste, and industrial waste) and how to best categorize the different types according to the report's methodology.

The emissions that result from the collection and transportation of waste and recyclables are an additional factor contributing to greenhouse gas emissions (MacBride, 2012b). Although the impacts of collecting and transporting waste and recyclables depend on a variety of factors (e.g., type of material, method of transport, distances to reprocessing and recycling facilities), generally, transportation is an integral consideration for the management of all types of waste. Numerous life cycle assessments (LCA) have been conducted to investigate these impacts in solid waste management systems (Clavreul et al., 2014; Liu, Hao, Dong, Yang, Zhang, & Ulgiati, 2017) and with different product categories (Vendries et al., 2018).

Total impact. Lastly, the impact of waste is increasingly conceptualized as proxy for the total impact of society's material consumption (EPA, 2009; Hoorneweg, Bhada-Tata, & Kennedy, 2014). End of life processes (e.g., landfill, incineration) represent just one phase of a material's life cycle that can extend backwards to encompass other phases like material extraction, transportation, manufacturing, and consumption. The U.S. EPA's shift from a waste management framework to a sustainable materials management paradigm (SMM) (EPA, 2009) as well as the growing use of life-cycle analysis tools and methodologies in the waste management sector signals this perspective change. An SMM perspective recognizes that solutions to society's waste issues cannot only address disposal.

Social issues. The effects of waste are compounded by the organization of societies and the distribution of wealth and power. This section outlines social issues that are integral to the understanding of waste's consequences: environmental racism and environmental justice, waste colonialism, and consumerism.

Environmental racism/justice. Environmental racism is defined as disproportionate environmental burden and harm that is placed on minority groups. An African American

community's protest of the siting of a toxic waste dump in Warren County, North Carolina in 1982 is credited as an origin point for the concept (Brenton & Galvin, 2012). While the Warren County protests were unsuccessful in preventing the dump's construction, they inspired research into the relationship between the locations of hazardous waste sites and minority communities. The landmark study "Toxic Wastes and Race in the United States: A National Report on the Racial and Social Economic Characteristics of Communities of Hazardous Waste Sites," by the United Church of Christ's Commission for Racial Justice found race to be the most significant factor that correlated with the communities where toxic waste sites were located (United Church of Christ, 1987).

The broader term "environmental justice" advocates for the equitable treatment of all people, regardless of race, class, or sex, and that no group should endure disproportionate environmental burdens. Many environmental justice cases have concerned waste-related issues and the siting of waste-related facilities (e.g., hazardous waste dumps, incinerators, landfills).

Waste colonialism. Waste colonialism refers to transboundary movement of hazardous or toxic waste from countries of high GDP and influence to countries of low GDP and power. Like other forms of colonialism, it represents one nation exerting power over and exploiting another nation. The term waste colonialism originated during the United Nations Basel Convention in 1989 (Liboiron, 2018b). Common materials that are moved between countries include, "electronic-waste, persistent organic pollutants, industrial waste, decommissioned ships, municipal solid waste, radioactive waste, and other toxic waste" (Liboiron, 2018b, par.3).

Consumerism. Finally, consumerism, and the connection between consumption, resource extraction, mass production, and waste, must be noted. Although the term has multiple definitions, contemporary consumerism denotes the social practice of acquiring consumer goods

to create and signal social identity and status (Tauxe, 2012). This material consumption is encouraged through advertising, the media and pop culture, and design techniques, like disposability and planned obsolescence. While companies, corporations, and other vested interests, rely on a consumerist culture to maintain profit margins, many criticize the numerous negative outcomes such a system produces.

Politics & economies. In addition to the social dynamics described above, the consequences of solid waste occur within political and economic systems. This section addresses how political and economic forces moderate waste issues in the United States by outlining the role of local, state, and federal government in waste and materials management and the trend of privatization and consolidation within the waste management sector. Finally, this section will demonstrate how tensions within waste management between public and private orientations in the United States can precipitate or exasperate waste consequences.

Government Role. In the United States, local and state governments are largely responsible for solid waste management rather than the federal government, though they are guided by federal solid waste regulations and funding opportunities. In earlier periods of American history, waste management constituted the private enterprise of scavengers, who found value in discarded materials and private contracts for collection, and disposal and street cleaning projects funded by wealthy landowners and merchants (Strasser, 1999). However, the sanitary reform movement and Progressive Era policies of the early 20th century, brought waste management services under the oversight and responsibility of newly formed municipal institutions (e.g., public works, sanitation departments) (Strasser, 1999, p. 118). This configuration would remain largely unchanged until the middle of the century, when the environmental movement of the 1960's and 1970's, which increasingly viewed solid waste as a

serious pollutant, led to the first federal legislation regarding solid waste—the SWDA of 1965 (Melosi, 2008).

The SWDA's primary goals were to initiate research examining waste problems and to assist local and state governments with program development for a variety of waste projects (e.g., collection, separation, disposal) (Melosi, 2005, p. 201). Subsequent amendments to the SWDA, most notably the RCRA of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984, shifted the federal government's focus to recycling and resource recovery issues, established rules and regulations for the tracking, handling, and disposal of hazardous waste, and created minimum standards for waste disposal facilities (Melosi, p. 203, 2005). These federal policies precipitated states to develop solid waste policy.

Because of the federal solid waste legislation, states pushed to create solid waste management plans and state waste agencies in order to receive federal funding. In 1965, there were no state solid waste agencies and minimal state involvement with waste-related issues; four and a half years, after the first federal assistance grant was dispensed, 44 states had programs devoted to solid waste (Melosi, 2005, p. 202). There was little coordination between states because many states based their programs off of their respective counties and municipalities' existing waste management plans (Melosi, 2005).

Although waste policy at the federal level was once impactful enough to precipitate state involvement, federal solid waste policy has since been criticized for its lack of consistency, scope, and power. Melosi (2005) outlines how cuts to the EPA by the Reagan administration affected the rollout and enforcement of many aspects of the RCRA during the 1980's (Melosi, 2005). MacBride (2012b) notes that federal solid waste policy lacks meaningful research and regulation regarding manufacturing and industrial waste. And, as previously mentioned, federal

policy has been criticized for not giving regulators enough power to enforce against polluters (Black, 2012). Regardless of level of government, however, the public sector's ability to manage and affect waste issues is complicated by the private sector and market forces.

Privatization and consolidation. Today, the majority of solid waste management services and infrastructures (e.g., collection and hauling, transfer stations, landfill operations and landfills, WTE sites) in the United States are run by private companies or publicly traded waste corporations. The Environmental Business Journal estimates that in 2017, the management of municipal solid waste in the United States was 70 percent private sector and 30 percent public sector (Young, L., 2018a). *The Waste Business Journal* estimates this proportion, in terms of overall revenue, is closer to an 80-20 percent split in favor of private over public (Waste Business Journal, 2017). In 2017, the top five publicly-traded waste corporations represented 48 percent of the industry, by revenue (Young, L., 2018a). A brief historical analysis reveals that America's solid waste system was not always organized this way.

The privatization of solid waste management dates back to the mid-20th century. Melosi (2008) notes that by the 1960's, municipalities spent approximately $1.5 billion per year on waste collection and disposal (p. 202). A confluence of factors starting from the middle of the century, however, increased the costs associated with waste management and created an untenable situation for local governments. America's swelling population and the rise of modern consumerism dramatically increased the volume of waste needing to be collected; suburban sprawl and the expansion of the U.S. highway system extended hauling distances and complicated collection routes (Melosi, 2008, p. 202). These factors, and many more, led municipalities to contract out rather than expand municipal services (Melosi, 2008). This trend continues in the present day as small or rural municipalities and counties often lack the resources

for the equipment, personnel, and infrastructure necessary for waste management (Rosengren, 2017; Young, J., 2018).

Concurrent with the trend of privatization, private waste companies have been consolidating via mergers, acquisitions, and a variety of other tactics. Rogers (2006) describes the sequence of business practices that larger, competitive waste companies often employ:

> … acquire existing infrastructure like transfer stations and landfills, buy or open small carting operations, edge out the competition by using predatory pricing or "low-balling" (charging less than fair market rates), then acquire the subsequently devalued local firms and dominate the market. (p. 187)

Changing government policy also contributes to the trend of consolidation. For example, the RCRA's provision that regulates non-hazardous solid waste, known as Subtitle D, established a series of design, safety and location standards for solid waste landfills (EPA, n.d.b). As a result of these stricter protections, smaller local firms and public operations could not afford retrofit their sites with these new measures (e.g., landfill lining, leachate abatement systems) and sold their operations (Rogers, 2006, p.185). Additionally, because of the corporate tax cuts of 2017, the waste management industry is forecasted to continue its trend of mergers and acquisitions (Rosengren & Boteler, 2018).

Public-private tensions. The question of whether waste and materials management services are more effective under public sector control versus private sector control, and even a mixed-control scenario (i.e., public-private partnerships), is beyond the scope of this section. However, we will now briefly address how tensions between public and private entities in waste management can precipitate and exasperate waste consequences. China's previously mentioned National Sword policy and its resulting effects on the U.S. recycling industry, as well as state and local solid waste issues, demonstrated this tension.

China's National Sword policy exposed the United States' reliance on exporting waste to other countries and revealed an underlying conflict between value-driven recycling practices and policy driven recycling goals. Announced in July 2017, National Sword banned the import of 24 types of solid waste and recyclables, imposed a .5 percent contamination rate on most scrap imports, and temporarily suspended import licenses as part of China's long-term goal of stopping the importation of recyclables by 2020 (Young, L., 2018b). In the short term, the global market for many key recycling commodities, of which China was a major buyer, constricted in 2018. The prices that many U.S. firms once sold common recycling commodities for either dropped significantly (e.g., "old corrugated container") or effectively vanished (e.g., mixed paper, mixed plastics #3-#7) (Young, L., 2018b). The United States net exports of plastics, for example, fell 35 percent from 3.7 billion pounds in 2017 to 2.4 billion pounds in 2018 (Staub, 2019b). The revenue from these now unsellable commodities were often also offsetting other less-profitable or lossmaking recyclable streams, further contributing to accumulations of recyclable material with no end destination. At the same time, waste companies and local governments were beholden to municipal or state diversion mandates that prohibited the landfilling of these accumulating materials.

These constraints left municipalities, counties, and states with few options: find funding to pay for higher waste and recycling service rates (e.g., emergency funds, taxes) or initiate stays on state or local policy that banned the incineration or landfilling of these recyclable materials. For example, the city of Philadelphia ended up paying a dramatically higher price ($80 per ton compared to $4 per ton the year before) to a waste contractor to recycle half of the city's recyclables. The rest of the recyclables were incinerated, much to the chagrin of communities and environmental organizations near the WTE site (Newhouse, 2018). The effects of National

Sword, however, were highly contextual (e.g., the market for other recyclable commodities remained strong, some regions did not rely heavily on foreign exportation) and some cities, counties, and states were affected much less than others.

The example of national sword demonstrates a fundamental tension between private and public entities in waste and materials management (Kessler & Engel, 2019). As the U.S. waste and materials management system is currently constituted, waste and recycling services are on the majority provided by the private sector and priced according to market forces (e.g., competition between bidding firms, markets for recyclable commodities). Kessler and Engel (2019) note the difficulties in reconciling these dynamic value-driven recycling practices with policy-driven recycling goals (e.g., diversion goals, recycling mandates, material bans) that often cannot flex with market-based forces (p. 24). Within the United States, these tension points have been demonstrated to contribute to existing waste issues that negatively affect humans and the environment.

Solutions and Progress

Society has conceived of and worked toward numerous solutions to manage the many issues stemming from solid waste. In 2019, society has undoubtedly made progress toward actualizing these solutions. This section will briefly address these advances through the broad perspectives of culture, policy, and sociotechnical systems. Although the United States is the primary context for this paper, topics addressed in this section can have broader origins and implications.

Culture. In order to better understand contemporary solid waste policy and management solutions in the United States, we will investigate the various cultural understandings of solid waste that underpin them. We will do this by describing relevant social constructions of solid

waste from the 20th and 21st century. Scholars have theorized around modern social constructions of waste and their ensuing implications for environmental policy and management (Strasser, 1999; Gille, 2007; MacBride, 2012b). The following social and cultural constructions of solid waste will be addressed under the following categories: sanitation and public health; environment and resource conservation; equity and justice; and most recently, cradle-to-cradle and zero waste.

- **Sanitation and public health** - The miasma theory of disease and the sanitary reform movement during the late 19th and early 20th century framed solid waste as a sanitation and human health issue. Coupled with Progressive Era reforms, solid waste became associated with a public service provided by local governments.
- **Environment and resource conservation** - The rise of the environmental movement of the 1960's and 1970's conceptualized solid waste as an environmental pollutant (Melosi, 2005). Books like Rachel Carson's Silent Spring, the events of Love Canal, and new research reinforced solid waste as an issue that affected humans and the environment. The first Earth Day celebrated in 1970 and the growing practice of curbside recycling, symbolized by the three-arrow recycling symbol, associated solid waste with resource conservation (Rogers, 2006; MacBride, 2012b). The practice of recycling was reinforced as an activity that would be beneficial to the environment.
- **Equity and Justice -** In addition to sanitation and public health, waste was also crucially conceptualized as an issue of class and race in the early 20th century. Before local governments assumed the responsibility of street cleaning, waste collection and disposal, the consequences of solid waste, as well as the hazardous occupations associated with it, were seen as disproportionally affecting poor communities (Strasser, 1999). Zimring

(2017) outlines that despite the institutionalization of sanitary services, waste issues continued to be used to reinforce structures of racism throughout the 20th century. The events of Warren County, North Carolina and the United Church of Christ report on environmental racism, clearly stated the connection between waste issues, class, and race.

- **Cradle-to-cradle and zero waste -** The dramatic rise of disposable packaging, single-use products, and modern society's consumerist culture prompted conceptualizations of a circular rather than industrial capitalist economy. McDonough and Braungart (2002) pioneered the concept of cradle-to-cradle, which posited that materials and products should be designed to be endlessly recyclable or reusable rather than disposable (i.e., cradle-to-grave). Zero waste, a similar cultural construction, has three current manifestations: research and scholarship aimed at actualizing circular economies, state and local solid waste policy premised around increasing diversion rates or banning the sale of single-use products, and individual lifestyle choices, popularized by the internet and social media, premised around reducing or eliminating one's personal waste.

Policy. Public policy has addressed the consequences of waste through all levels of government in a variety of different ways. We will now briefly address examples of waste policy in the United States on the federal as well as state and local level.

On the federal level, the RCRA is the primary policy program that addresses solid waste issues in the United States. As previously discussed, the RCRA encompasses laws, regulations, and policy guidance for the management of non-hazardous and hazardous solid waste. Although the program has many functions, some of its main responsibilities include: establishing and maintaining hazardous waste management systems and infrastructures, assisting states and tribes in developing their own solid waste management plans, preventing hazardous waste

contamination, promoting a sustainable materials management framework and practices, and enforcing and regulating its statutes (EPA, 2014). The CERCLA, or Superfund program, is another federal policy program that deals with the consequences of hazardous solid waste. As a result of the RCRA and CERCLA, many issues caused by solid waste have improved for the better.

State and local governments, guided and partially funded by the RCRA, are the primary government actors that deal with waste issues. First, state and local governments create and carry out the laws and regulations that collect, dispose of, repurpose, recycle, or otherwise manage waste and other materials. Regarding hazardous waste, states and tribes are authorized to carry out the RCRA's robust hazardous waste management program. The policies and practices that aim to protect human health and avoid environmental pollution from the immediate effects of solid waste (i.e., the management techniques of collection and disposal via landfilling and incineration) have already been addressed. However, state and local policy mechanisms that address waste issues through techniques other than landfilling and incineration have not. The progress state and local governments have made in addressing solid waste issues, through the categories of resource recovery, source reduction, and producer responsibility, will be briefly described.

States and local governments have instituted a wide variety of resource recovery laws for a range of different materials. Resource recovery generally refers to waste and materials management methods that divert materials away from end-destinations like the landfill or incineration (e.g., recycling, composting). Municipal curbside recycling is a significant form of solid waste diversion in the United States, "symbolically, economically, and institutionally" (MacBride, 2012b, p. 84). Curbside recycling programs first gained popularity in the early

1980's (Farina & Zimring, 2012) and are now a common service mandated by many municipalities. Many states require businesses and residences of a certain size to recycle and/or compost. Beyond curbside recycling, many other policies are gaining prominence on a state and local level. Increasingly, state-mandated food recovery policy is becoming more prevalent.

Local and state policy programs have also reduced the amount of waste being generated (i.e., source reduction) by instituting pay-as-you-throw (PAYT) service models, product bans, and finally by funding community reuse organizations. The PAYT model charges residents only for the waste they discard while also providing free recycling pick-up or drop-offs services and has been shown to reduce the total amount of discards that residents generate (Nagle, 2012; Nestor, 2019). Product bans are also increasingly popular policy mechanisms for state and local governments. Municipalities and states like California have instituted plastic ban bags (Rosengren, 2016). And the city of Berkeley, California banned the use of single-use plastic items with a city ordinance in 2019 (Li, 2019). Finally, state and local governments work towards source reduction by incentivizing reuse, either by providing funds for community reuse organizations or by incentivizing donations.

State and local producer responsibility laws are the third policy program that will be described. Producer responsibility laws, known as extended producer responsibility (EPR) address responsibilities after production, shifting the financial burden of disposal or recovery from the consumers to the manufacturer. EPR laws are regarded as powerful policy mechanisms when instituted properly (Leonard, 2010; Nestor, 2019). The bottle bill and tire take back programs are the most well-known. Ten states currently have some form of container deposit law, also known as bottle bills, which apply to glass and plastic containers (MacBride, 2012b). In

2019, most states and many local governments have instituted some form of EPR law, covering products such as batteries, electronics, and paints (Product Stewardship Institute, 2019).

Socio-technical Systems. Finally, the progress of solid waste solutions will be analyzed through the lens of sociotechnical systems. Sociotechnical systems encompass technical infrastructure as well as "actors, networks and institutions, including legal frameworks, that provide services related to the technology; e.g. operators, legislators, financers, and supporting infrastructure systems" (Mcconville, 2019, par. 3). Such a framing is important because it recognizes that waste and materials management systems and solutions are not comprised solely of technological components, but also social, political, and economic factors. Addressing the considerable scholarship around sociotechnical systems and sustainability (Siddiqi & Collins, 2017) is beyond the scope of this paper, however a sociotechnical system framing allows for solid waste solutions, which often comprise multiple actors in complex, open systems, to be discussed.

Since 1980, Americans have increased their recycling and composting rates from less than 10 percent of the total amount of MSW generated to 34.7 percent of total MSW generated in 2015, or 91 million tons (EPA, 2018a). Composting, in particular, has increased from negligible rates in 1980 to 23.4 tons in 2015 (EPA, 2018a). Furthermore, according to the EPA, some materials with the highest recycling rates in 2015 were lead acid batteries (99 percent), corrugated boxes (92.3 percent), and steel cans (71.3 percent) (EPA, 2018a, p.9). Collectively, these landfill diversion efforts reduced greenhouse gas emissions by more than 181 million metric tons of carbon dioxide equivalents in 2014, equivalent to the annual emissions of 28 million passenger cars (EPA, 2016). By economic metrics, the recycling and reuse sector in the

United States constitutes 757,000 jobs and $36.6 billion in wages in 2007 (the earliest available year to analyze) (EPA, 2018a).

New research and development into waste and materials processing technologies also represent possible waste solutions. Plastic processing methods like depolymerization and pyrolysis, categorized broadly as "chemical recycling" or "advanced plastics recycling," are regarded as promising recovery methods that could complement existing mechanical recycling infrastructure (Leif, 2019b). And new sorting methods that utilize robotics and machine learning have the potential to increase the efficiency of MRFs (Peters, 2019). Similarly, the anaerobic digestion of organic waste, which has been successfully deployed in European Union countries, has potential to divert significant amounts of organic waste from the landfill (Hanselman, 2018).

Challenges to Overcome

According to Rittel and Webber's (1973) concept, solutions to wicked planning problems generate a number of consequences of their own (both good and bad) and have no clear end point (p.162-3). Solutions, therefore, must be continually evaluated as to whether they are achieving their intended goal. In other words, a discussion around the progress of waste solutions necessarily begets a discussion regarding their shortcomings and additional challenges. Current challenges to the field of waste and materials management will be described through the following broad categories: modern recovery challenges, flawed indicators, ideological differences, and social constructions and cooptation.

Modern recovery challenges. The complexity of the modern material economy poses many challenges for the actors and institutions involved with resource recovery solutions. The diversity of plastic products and the processing challenges that they pose to municipal recycling systems is a good example. Even plastics with the same resin identification code (e.g., #2, high-

density polyethylene), for example, exhibit a wide range material attributes as a result of differing production methods and chemical compositions (Liboiron, 2013). Liboiron (2013) explains how this material heterogeneity complicates recycling:

> To make plastic waste into plastic products with identical properties (flexibility, clarity, flame resistance, or strength, for example), stock has to be homogenous, raw materials have to be in high supply, and costs of production have to be reasonable in comparison to using cheap virgin materials. For plastics, these conditions are rarely met, with the exception of clear plastic soda pop bottles (PET). (195).

Beyond plastics within the same resin code, the rise of compostable plastics has also complicated plastics recycling, as compostable products are often hard to distinguish from their petroleum-based counterparts (McSweeney, 2019). Finally, some stakeholders question the sincerity of larger, private waste and materials management service providers since these companies often control both recovery and disposal systems (Corkery, 2019). In other words, if a company generates the same or more revenue from providing its disposal services rather than its recovery services, is the company truly incentivized to provide recovery programs? These recovery challenges contribute to the critique of municipal recycling programs by scholars and writers (McDonough & Braungart, 2002; Rogers, 2006; Leonard, 2010; MacBride, 2012b).

Flawed indicators. The field of waste and materials management increasingly acknowledges the flaws of some of its prominent performance indicators. The inadequacy of diversion metrics and the inconsistencies across states and local diversion methodologies will be discussed. Finally, the growing critique of key assumptions foundational to establishing the environmentally beneficial nature of recycling will also be discussed.

As previously discussed, the field of waste and materials management is moving beyond a simple tonnages-diverted metric to communicate the environmental and social impact of their work (Leif, 2017). One of the major reasons behind this shift is the lack of consistency in how

state and local governments arrive at their diversion metrics and whether or not they include ICI waste sources within their calculations (Moore, B., & Engel, 2016; Leif, 2017). MacBride (2013) outlines how San Francisco's 80% diversion rate is in part due to the fact that the city categorizes large amounts of construction material and biosolids as diversion in their calculations. Finally, foundational assumptions that designate diversion, and in particular, material recycling, as environmentally and socially beneficial are being challenged and critiqued (Geyer, Kuczenski, Zink, & Henderson, 2015; Zink & Geyer, 2018). Zink and Geyer (2018) demonstrate that the environmental and social benefits of recycling rely on its ability to displace primary production of virgin material, which is often overstated.

Ideological differences. Some posit that measurable progress cannot be achieved without rectifying the ideological differences undergirding waste and materials management solutions. Ideology is defined by the New Oxford American Dictionary as a set of ideas and ideals that influence economic and political theory and policy. Many waste scholars have noted the tensions between waste solutions that are founded on public versus neoliberal ideology (MacBride, 2012b; Hird, Lougheed, Rowe, & Kuyvenhoven, 2014; Liboiron, 2018a). These tensions will be discussed by outlining mandated versus voluntary producer responsibility policies and the scalar mismatches in waste.

Policy battles over EPR—whether companies should bare the environmental and social costs of their product throughout its life cycle—reveal a clear division between political ideologies. There are many forms of EPR (e.g., whether a producer takes on the economic responsibility or physical responsibility of managing their product) and mechanisms (e.g., deposit refund, advanced disposal fee, voluntary) (Roy, 2012). Although a variety of EPR laws exist on the state level and are regarded as powerful policy mechanisms for environmental and

social protection (Leonard, 2010; Miller, 2019), others regard EPR mandates as restrictive, both on corporations and consumers. Some argue that mandated EPR laws raise prices for consumers and slow funding for technical innovation, like the Closed Loop Fund (Roy, 2012). Service providers are also often stuck in the middle of the forces generated by these opposing policies. For example, both private and public waste and materials managers opposed New York state's proposed bottle bill expansion because it would cut into the valuable commodities their systems already gathered through municipal collection programs (Geyn, 2019).

Others point to the scalar mismatch between research on MSW versus ISW as emblematic of our current ideological regime (Leonard, 2010; MacBride, 2012b; Hird et al., 2014; Liboiron, 2014). The best available estimates indicate that municipal solid waste makes up 2.5% of all of waste generation in the U.S. annually; industrial solid waste (i.e. waste produced by industrial processes and manufacturing), by comparison, makes up 76% (Leonard, 2010, Chapter 10).

Social constructions and cooptation. As a corollary to the challenge of overcoming ideological differences, scholars have also tracked and demonstrated how social constructions of waste and their connected environmental movements have been coopted by certain actors to further their own goals. Rogers (2006) outlines how packaging manufacturers created the non-profit Keep America Beautiful to generate community and political awareness around the issue of litter, which reinforced the notion that environmental pollution was the individual's responsibility, and not corporations (p. 145). Rogers also points out that the recycling symbol creation was sponsored by the Container Corporation of America, for the first Earth day in 1970 (p. 171). MacBride (2012b) notes that while community and grassroots actions have undoubtedly

produced victories for environmental justice and environmental regulation, they can also be easily coopted and diverted from addressing more pressing waste issues.

Environmental Psychology Perspective

The study of waste and materials management within environment and behavior research understandably focuses on individual or group behavior change. The research has identified a range of psycho-social and environmental variables that influence behavior and has outlined opportunities for waste-related behavioral interventions. In the following text we briefly consider the ways waste has been studied by environment and behavior research, how waste-related behaviors are often studied under a wide umbrella of pro-environment behaviors, and, finally, how such a perspective can bias certain solutions over others.

The field of environment and behavior research has concerned itself with waste behaviors and psychology as early as the 1970's (Arbuthnot, 1974; Humphrey, Bord, Hammond, & Mann, 1977). Oskamp, Harrington, Edwards, Sherwood, Okuda, and Swanson (1991) studied a range of demographic, attitudinal, and behavioral variables that possibly affected recycling behaviors or the adoption of the practice. Oskamp et al. (1991) found that living in a single-family home or owning one's home, in comparison to living in an apartment complex or renting, to be the most significant variable contributing to recycling behavior, suggesting that the theorized link between attitude and behavior was influenced by other factors. A literature review by Schultz, Oskamp, and Mainieri (1995) acknowledged a wide range of behavioral antecedents that researchers had identified (e.g., commitment, norms) but highlighted major limitations in the body of research, like a lack of research on the interaction of variables, the longitudinal effectiveness of interventions, and whether recycling behavior for one material carries over to others. Duffy and Verges (2009) researched the effects of affordances (i.e., waste container design) on recycling

contamination. A meta-analysis by Varoto and Spagnolli (2017) of validated field interventions highlighted successful intervention types and behavioral antecedent variables while reiterating a need to evaluate the long-term effectiveness of interventions and move away from self-reported variables.

Waste-related behaviors (e.g. recycling, composting, reuse) have also popularly been incorporated as sub-domains of much larger environmentally concerned constructs related to environmental values, behaviors and beliefs, such as ecological and environmentally significant behavior (Kaiser, 1998; Stern, 2000; Stern, 2011), green or sustainable lifestyles and consumption patterns (Barr & Gilg, 2006; Peattie, 2010; Axon, 2017) and pro-environmental behavior (PEB) (Thøgersen & Crompton, 2009; Steg & Vlek, 2009; Truelove, Carrico, Weber, Raimi, & Vandenbergh, 2014). Interestingly, waste related behaviors and particularly recycling, was found to occupy a substantial portion of "the literature on PEB" (Osbaldiston & Schott, 2012, p. 264).

New Approach

As outlined in the previous section, we acknowledge the immense contribution environment and behavior research has made for the field of waste and materials management. Research on important behavioral antecedents has helped planners and policy-makers shape waste-related policy programs and behavioral interventions. However, we advocate for future environment and behavior research on waste to embrace a wicked planning perspective by returning to inductive research projects. This new, exploratory approach should be advanced for two reasons: (1) definition work (i.e., determining the nature and scope of the problem) is important and can be influenced through research, and (2) existing environment and behavior methodologies, in particular the conceptual content mapping tool, are powerful tools that can

engage stakeholders to frame wicked waste problem-definitions.

Returning to the example of ocean plastics pollution, Liboiron (2013) highlights how problem-definitions have been used by different stakeholders to frame the overall issue (or non-issue) of plastic pollution (Liboiron, 2013, p.14). Indeed, waste scholars have identified how certain definitions of the problems of waste have contributed to or reinforced the consequences and challenges of waste discussed in previous sections (Liboiron, 2013; MacBride, 2012b; Hird et al., 2014). As MacBride summates:

> There is also a problem with the definition of social problems to begin with— a problem with the notion that personal responsibility, visibility, locality, and closeness to home are overused to understand what is wrong with solid waste and all environmental ills (MacBride, 2012b, p. 14).

Even given a psychological and behavior focus, the field of environment and behavior must recognize that the continued focus on the individual and a narrow set of codified behaviors (e.g., recycling) will reinforce the framing and definition of waste management solutions as the responsibility of the individual consumer and techno-scientific technologies (Hird et al., 2014). In other words, behavioral researchers should be wary of perpetuating problem-definitions that unequally benefit certain stakeholders through their work. While deductive research should work from specific and discrete problem definitions and operationalizations, we see exploratory research as paramount as well.

The second claim of this new approach therefore finds researching stakeholder perspectives as necessary and foundational work to any subsequent problem-definition or solution-oriented work. In this regard, the conceptual concept cognitive mapping (3CM) tool, developed by Anne Kearney and Stephen Kaplan, is an apt tool for stakeholder engagement. Kearney and Kaplan (1997) description of 3CM, reiterates this claim:

> the benefits of externalizing decision makers' maps bringing them to the surface so that they might be examined, compared, and discussed cannot be underestimated. Doing so can expand people's conceptualizations of the problem, pinpoint areas of disagreement, highlight areas of potential agreement, and provide a foundation on which to base a discussion and, ultimately, a decision. (p.579).

Therefore, this thesis contributes to the work of addressing (and defining) wicked waste problems by utilizing an existing environment and behavior stakeholder research tool. Many of our research questions were concerned with how stakeholders define and conceptualize the issues of waste and waste management (RQ1,2,3). Other questions investigated how these conceptualizations differ between groups (RQ 4 A,B,C). Lastly, two research questions investigated the plurality of stakeholder and problem definitions (RQ 5,6) held by the different participants.

Research Questions

RQ 1: What are the characteristics of participants' conceptual maps of 'good waste management'?

RQ 2: What are the major items or concepts across all stakeholder groups?

RQ 3: Are there key themes among stakeholder groups' conceptualizations of proper waste and materials management?

RQ 4: How do groups compare in their conceptualizations of proper waste and materials management:

A) Are there key differences and/or similarities among stakeholder groups' conceptualizations of proper waste and materials management?

B) Does participation in pro-environmental behaviors predict key differences between participants' conceptualization of proper waste and materials management?

C) Do demographics or work experience predict key differences between participants' conceptualizations of proper waste and materials management?

RQ5: Who are the stakeholders in waste and materials management, according to the participants?

RQ6: What are the salient issues facing waste and materials management today, according to the participants?

CHAPTER 2

Method

Participants

This study collected data from 21 individuals (n=21) within the waste and materials management industry in New York State, primarily from counties in the central and upstate New York region. Figure 1 shows the counties in which participants were located. Participants worked at private and public entities and included a range of positions (e.g. directors, managers, staff-persons) on a local, county and regional level. Participants had worked in a field related to waste for an average of 14.2 years (min. 2 years, max. 38 years, std. deviation 10.1 years). Most participants were in the age range of 35-55 years. Twelve women and 9 men participated. Stakeholders who worked in county government were found online through their respective official government websites and subsequently contacted. Other participants were identified through a snowball sampling approach through which additional stakeholders were solicited from initial participants. A total of 46 individuals were contacted and 21 (45%) were able to participate in the study.

This study focused on three major stakeholder groups: private waste companies, local government, and community-based reuse organizations (MacBride, 2012b). These three groups are among seven described by MacBride (2012b) as key actors within materials management systems; our study did not address other key actors (i.e., manufacturers, scrap industry, environmental lobbying groups) (p.16-7). A sample size of at least eight participants per stakeholder group was targeted (Austin, 1994; Kearney, Bradley, Kaplan, & Kaplan, 1999), however, the ultimate sample included 10 participants from local government, 8 participants from community reuse organizations and 3 participants from private waste companies.

Finally, participants in the study dealt with a range of different material streams through their work. Of the 21 participants, 4 participants dealt specifically with food and organic wastes, 6 participants dealt with only MSW and C&D waste (excluding organics), and 11 participants dealt with a multiple waste streams, which included MSW, C&D waste, food waste, and industrial waste.

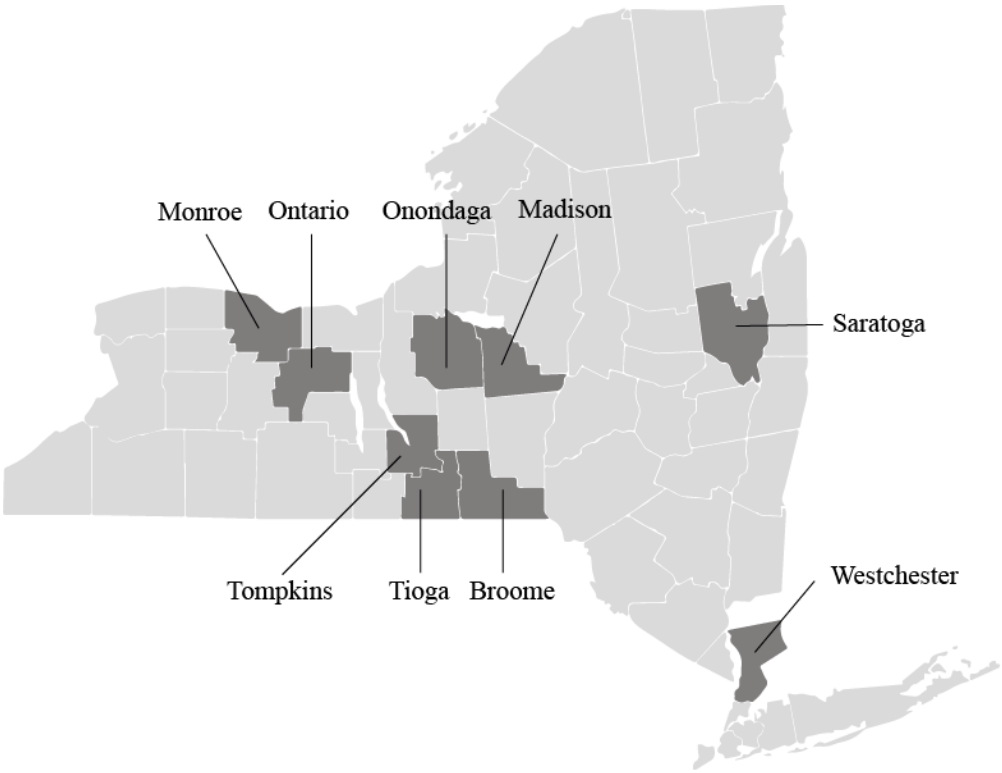

Figure 1 Map of New York counties where participants were located, n=21

Setting

Although wicked waste problems are often national or international in terms of scope, our research focused on stakeholders in the upstate region of New York State. Although practical considerations (e.g., time, travel, resources) were the primary reason the study focused on New York State, the focus on NY is also beneficial from a research design perspective. Within the United States, each state and tribal nation has their own unique solid waste management plan

which in turn influences the policies and programs on a state and local level. Therefore, one advantage of this focus was that all stakeholders were operating within the same context of New York State.

New York's first solid waste management policy was adopted in 1987 during a period known as the solid waste crisis (New York Department of Environmental Conservation, 2010). New York's most recent solid waste management plan, titled "Sustainable Materials Management Strategy – Beyond Waste" was adopted in 2010 by the New York State Department of Environmental Conservation (DEC). Counties and local governments can form (independently or jointly) a planning unit to create a local solid waste management plans. There are 69 recognized planning units in the state of New York. New York's current waste management plan established policy strategies through 2020 and state and local waste goals through 2030 (NYDEC, n.d.). One of its notable goals is to reduce New York state's per capita waste generation to 0.6 pounds per day by 2030 (NYDEC, 2010).

Constructs and Measures

Cognitive maps of waste & materials management. Conceptual Content Cognitive Mapping (3CM) is a qualitative/quantitative research technique that allows participants to physically visualize their knowledge structures, or 'mental maps,' of a particular concept or topic (Kearney & Kaplan, 1997). Just as people have cognitive maps or mental models that enable them think about and navigate physical environments such as buildings and cities, humans also have cognitive representations of conceptual domains. 3CM focuses on individuals' knowledge of "conceptual content" rather than spatial geographies (Wells, 2005, p. 192). As Kearney and Kaplan (1997) write, "the benefits of externalizing decision makers' maps—bringing them to the surface so that they might be examined, compared, and discussed—cannot be underestimated"

(Kearney & Kaplan, 1997, p.579). In environment and behavior research, the 3CM method has been used to study perceptions of hazardous waste sites on tribal land (Austin, 1994), appropriate forest management (Kearney & Bradley, 1998; Kearney et al., 1999), participatory housing experiences (Wells, 2005), sustainable development (Byrch, Kearins, Milne, & Morgan, 2007), and green citizenship (Guckian, Hamilton, & De Young, 2018; Hamilton, Guckian, & De Young, 2018). Given the complexities of waste, waste management, and the plurality of both stakeholders and stakeholder perspectives and goals, 3CM is a promising instrument for this study. The study's use of the 3CM tool to analyze stakeholder perspectives on appropriate waste management represents the first time the tool was used in the field of environment and behavior research to study waste.

Several variants of the 3CM technique are available to researchers depending on their research goals: open-ended, structured, and hybrid. Open-ended 3CM exercises ask the participants to express their own concepts, themes, and ideas in the creation of their concept map. Structured 3CM exercises, by contrast, provide the participant with items (often based on prior, open-ended 3CM's) from which to construct their map. While structured 3CMs require extensive pretesting to generate the relevant concept items, they are less time-consuming to administer than their open-ended counterparts and are therefore better suited for studies with larger sample sizes (Guckian et al., 2018). Structured 3CMs are also preferable for more robust statistical analysis (e.g. cluster analysis) because the generated data is easier to analyze (Kearney, 2015). Studying green citizenship, Hamilton, Guckian, and De Young (2018) and Guckian, Hamilton, and De Young (2018) implemented a hybrid 3CM methodology where participants were given pre-made items in addition to the option to generate their own items during their

3CM task. Due to the exploratory nature of this study, an open-ended 3CM methodology was utilized.

Multi-dimensional pro-environmental behavior. In addition to the 3CM task, participants' pro-environmental behaviors (PEB) were measured using a 13-item scale (Larson, Stedman, Cooper, & Decker, 2015) that contained four PEB subdomains: conservation lifestyle behaviors, land stewardship behaviors, social environmentalism, and environmental citizenship behaviors. Each domain was found to have acceptable levels of internal consistency (reliability) with a Cronbach's alpha of 0.786 for conservation lifestyle behaviors, 0.638 for land stewardship behaviors, 0.782 for social environmentalism and 0.839 environmental citizenship behaviors (Larson et al., 2015). Confirmatory factor analysis was used to assess the convergent and discriminant validity of the PEB constructs and found that the path loading for each construct was ≥ 0.49 and all values were statistically significant. Error variances for the observed variables ranged from 0.23 to 0.76 (Larson et al., 2015).

Demographics. A series of demographic questions were posed to participants. These questions, presented in writing, included: age, gender, job title, number of years working in the field, and highest level of education (Appendix A).

Semi-structured interview questions. After participants completed the survey, the researcher asked the participant a series of structured questions regarding the waste management industry broadly followed by more specific stakeholder-related questions. The semi-structured interview script followed Zeisel's (2006) protocol for focused interviews (p. 227). There were four structured questions that the researcher asked each participant:

- "What does 'waste' represent to you?"
- "What does 'waste management' mean to you?"

- "Who are the stakeholders in 'waste management'?"
- "What are some of the key challenges for the industry?"

The interview script can be found in the appendix (Appendix B).

Procedure

Most participants were interviewed at their workplace. Interviews were conducted in participants' offices or in conference rooms depending on space and noise constraints. If the participant was not able to meet at their place of work, a quiet, public area was chosen by the researcher and participant as a place to conduct the interview. The researcher briefed the participant the purpose of the study and led them through each phase of the study protocol.

The study protocol had three distinct phases: first, researchers led the participant through the 3CM task; second, participant completed the pro-environmental behavior scale developed by Larson et al. (2015) and demographic questions; lastly, the researcher conducted a short semi-structured interview with the participant. The survey and semi-structured interview portions were deliberately administered after the 3CM task to avoid biasing the participant's mental maps. The specific procedures for each phase are described below.

3CM task. The 3CM task constituted multiple steps but at its core asked participants to generate and sort all concepts that related to their knowledge structure of waste management, and particularly what "good waste management" represented to them. The participant's first task involved identifying and generating key factors or concepts the participant deemed relevant to appropriate waste management. The participant wrote each of these concepts, factors, and items on separate yellow sticky note provided by the researcher. These items were elicited via the following instructions:

1. "*I'd like you to think about your own perspective on 'good waste management' and imagine that you are explaining your perspective to someone who is unfamiliar with waste management issues or concepts. What are some of the things, concepts, or ideas you would talk about? What would be important to consider or address in practicing good waste management*?"

If the participant did not immediately understand the prompt, the researcher would describe an example 3CM topic (e.g. "How to successfully navigate Grad School") and example concepts, factors or items (e.g. "time-management", "good nutrition", "mentorship"). As participants identified items, they wrote down each item on a card. While researchers encouraged participants to "talk-out" their ideas and helped them refine their concepts, researchers consciously avoided proposing new items for participants so as not to bias participants responses.

Next, the participant grouped together items based on the following prompt:

2. *"Please look over the collection of items you've just written down and group items that belong together in a way that makes sense to you."*

Then, participants were asked to label their item clusters and explain their groupings. Participants were given blue sticky notes by the researchers to label each cluster. The instructions were:

3. *"Now please add labels to each group or cluster you've created--the labels describing the manner in which the items are categorized."*

Participants were encouraged to add more items from step one if they thought of new or appropriate items during subsequent step. Finally, the participant was given one last opportunity to add items before the participant and researcher reviewed the completed cognitive map together. Participants' final 3CM maps contained the concept items they generated arranged into

clusters of their choosing designated by group labels. One example of a completed 3CM is shown in Figure 2.

Figure 2 One example of a participant's 3CM. Concept items were written on light-colored sticky notes and group labels were written on dark-colored sticky notes.

Survey and interview. After the 3CM task, participants were given the PEB survey to complete (Appendix A). After participants finished the survey, the researcher led participants through a semi-structured interview which contained general and stakeholder-specific questions. Participants were asked the following four general questions:

- #1: "What does 'waste' mean to you?"
- #2: "What does 'waste management' mean to you?"
- #3: "Who are the stakeholders in waste management?"
- #4: "What are some of the most important issues facing waste management today?"

Sometimes participants were asked to expound upon details in their 3CM map or specific questions related to their job. After completing the interview stakeholders were thanked for their participation in the study and given compensation of $25.

Analytic Strategy

The study's overall analytic strategy and its methods were informed by the study's research questions. Given the amount of qualitative and quantitative data collected, it was important to only employ techniques that helped answer our original research questions (Kearney, 2015, p. 285). Data were analyzed using combination of qualitative and quantitative techniques and software: the maps were analyzed using Atlas.ti software (version 8.3), Excel (version 16.19), R (version 3.5.1), and RStudio (version 1.1.456), and SPSS (version 25); descriptive statistics were run using Excel and SPSS; cluster analysis was performed using R and RStudio. The analytic techniques, software, and any additional processes used for each research question are described below. Finally, the study's research questions are grouped into three distinct categories of inquiry according to their method: questions regarding participants' 3CM maps (RQ 1, 2, 3), questions regarding between-group comparisons of participants' 3CM maps (RQ 4A, 4B, 4C), and questions regarding the stakeholder interview-responses (RQ 5, 6).

3CM Maps

RQ 1: What are the characteristics of participants' conceptual maps of 'good waste management'? Since an open 3CM study was conducted, participants' maps were coded before any quantitative analysis could be performed. The coding process involved coding items by theme. For example, the code "Education" represented a variety of verbatim responses that were similar but not identical (e.g., "educate", "educate the public", "educate all parties involved"), see Appendix C. The coding process involved three iterations. The lead author plus two judges

analyzed the first 13 concept maps and created 40 codes from the items produced by the participants. After this initial phase, the lead author and one other judge further developed this list to create 62 codes. Finally, the lead author coded all maps using Atlas.ti software (version 8.3) yielding a final list of 91 codes for cluster analysis. Twenty items from the total pool of items (404) created by participants could not be categorized and were excluded from any further analysis (labeled "Miscellaneous" in Appendix C). Initial analysis began with 384 items, 97 group labels, and 91 code categories. See Appendix C for a codebook of all 404 items, 97 group labels, and verbatim responses. Finally, descriptive statistics were used to answer RQ 1.

RQ 2: What are the major items or concepts across all stakeholder groups?

Participants' responses were also converted into a binary dataset before further analysis. In other words, the dataset indicated if participants mentioned (=1) or did not mention (=0) a conceptual item. Although this step reduced the number of total item frequencies from 384 to 287, the step was necessary to ensure that no 3CM response unduly affected the cluster analysis phase (RQ3). For example, if a participant's 3CM map contained multiple instances of the concept item "Education", that particular 3CM map would affect the placement of "Education" more than maps that just mentioned the concept once. Before conversion, 96.5% of the dataset was already binary (i.e., participants either mentioned a concept once or not at all). Next, items that were only mentioned by participants two times or fewer were removed. The final dichotomized dataset represented a total of 228 items and 59 item codes and only included items mentioned by 3 or more participants (i.e., 14.3% of the participants or more). RQ2 was answered using descriptive statistics of the raw dataset and the binary dataset.

RQ 3: Are there key themes among stakeholder groups' conceptualizations of proper waste and materials management? Hierarchal cluster analysis and frequency analysis

were used to answer RQ 3. To examine the possible thematic similarities and differences in participants' 3CM maps, a dendrogram (Figure 3) was created using RStudio. The tree diagram represents similarities in how participants grouped the 59 concept items together across all participant maps. As Hamilton, Guckian, and De Young (2018) write, the dendrogram represents "how each item is clustered together with the other items, one at a time, in order of the two most similar items (i.e. the two items people most often grouped together), followed by the next most similar item, etc." (p. 323). In other words, the dendrogram represents the hierarchy of similar items clustering together. Interpreting a dendrogram's resulting clusters is a subjective process. A high threshold produces large group clusters that might contain too many disparate concept items and therefore lack coherence. A low threshold produces smaller group clusters but runs the risk of those groups losing salience (Guckian, Hamilton, & De Young, 2018). We reviewed the cluster analysis and iteratively generated categories using different threshold levels. Finally, we came to a consensus on the organization of eight thematic cluster groups based on the coherence of the individual cluster groups. A frequency analysis was also conducted for the individual concept items within each theme cluster.

Between-Group Comparisons

RQ4 examines: How do groups compare in their conceptualizations of proper waste and materials management? This RQ is addressed by three specific questions, 4A, 4B and 4C:

RQ 4A: Are there key differences and/or similarities among stakeholder groups' conceptualizations of proper waste and materials management? Frequencies were analyzed to address RQ4A between the "Local Government" and "Community Reuse Organization" stakeholder groups. Because the "Private waste" stakeholder groups group population was so small (n=3) the group was omitted from frequency analysis.

RQ 4B: Does participation in pro-environmental behaviors predict key differences in the content of participants' conceptual maps of proper waste and materials management? Descriptive statistics were used to analyze the scale responses and generate participant groupings for RQ 4B. Frequency analysis was performed on the resulting groupings.

RQ 4C: Do demographics predict key differences between participants' conceptualizations of proper waste and materials management? Comparisons of major themes by certain demographic variables (i.e., gender and job years) was conducted. Frequency analysis was conducted on these groupings to answer RQ4C.

Interview Questions

RQ5: Who are the stakeholders in waste and materials management, according to the participants? Regarding the open-ended interview questions, participant responses were transcribed (Appendix D) and coded using Atlas.ti. Additionally, 20 out of the 21 participants completed the open-ended interview portion. Questions #1 ("What does waste represent to you?") and #2 ("What does waste management mean to you?") were considered "warm-up" question for the participants and therefore not included in further analysis. Participant responses to Question #3 ("Who are the stakeholder's in 'waste management'?") were coded and analyzed. The coding process involved one iteration. The lead author analyzed participant responses and created 27 codes based on responses. Descriptive statistics were used to answer RQ 5.

RQ6: What are the salient issues facing waste and materials management today, according to the participants? Participant responses to Question #4 ("What are some of the most important issues facing waste management today?") were coded using Atlas.ti. The coding process involved one iteration. The lead author analyzed participant responses and created 17 codes based on responses. Descriptive statistics were used to answer RQ 6.

CHAPTER 3

Results

Statistical and qualitative analysis of the 3CM, PEB and demographic surveys, and interview data are presented according to the research questions. RQ 1, 2, 3 address inquiries stemming from the 3CM method; RQ 4A, 4B, 4C address inquiries stemming from between-group comparisons; finally, RQ 5, 6 address inquiries stemming from the interview data.

RQ 1: What are the characteristics of participants' conceptual maps of 'good waste management'?

Stakeholders (n=21) created an average of 18.29 items and 4.62 groups per concept map. The total number of items created by participants (384) represented 91 discrete concepts. Since stakeholders participated in an open 3CM format, participants were not restricted from including an item (i.e., Education, Politics) more than once in their concept map.

3CM Component	Total #	Mean	Max #	Min #
Concept Items	384	18.29	34	5
Concept Groups/Labels	97	4.62	11	2

Table 1 Characteristics of 3CM Maps (n=21).

RQ 2: What are the major items or concepts across all stakeholder groups?

Table 2 shows all concept items and their frequencies in the raw and binary datasets. The five most-mentioned concept items and their frequencies in the "Raw" dataset were: Education (16), Reduction (13), Reuse (12), Waste Management – Marketing (12), and Psychology – Mindset Change (10). The five most mentioned concept items in the "Binary" dataset and their frequencies changed to: Education (9), Reduction (8), Reuse (7), Policy – Regulation (6), and Producer Responsibility (6).

Item	Frequency (Raw)	Frequency (Binary)	Item	Frequency (Raw)	Frequency (Binary)
Education	16	9	Behaviors - Proenvironmental Behavior*	3	2
Reduction	13	8	Communication	3	3
Reuse	12	7	Costs*	3	2
WM - Marketing	12	5	Cradle to Cradle*	3	2
Psychology - Mindset Change	10	4	Design - Environmental	3	3
Funding Mechanisms	8	4	Design - Packaging	3	3
WM - Separation (Importance of)	8	4	Education - Public Awareness	3	3
Behaviors - Conscience Consumerism	7	5	Funding Mechanisms - Taxes	3	3
Communication - Outreach	7	5	Good Intentions*	3	2
WM - Programs/Programming (importance of)	7	3	Markets	3	3
Community (Importance of)	6	4	Markets - Fluctuation	3	3
Environment (Importance of)	6	5	Politics	3	3
Funding (Need for)	6	4	Psychology - Behavior Change	3	3
Policy - Regulation	6	6	Repair	3	3
Producer Responsibility	6	6	Stakeholders	3	3
Responsibility/Accountability	6	5	Stakeholders - Government	3	3
Stakeholders - Haulers	6	3	Stakeholders - Manufacturer	3	3
Status Quo BAD	6	4	Stakeholders – Nonprofit*	3	2
WM - Services	6	3	WM - Purchasing	3	3
Behaviors - Compost	5	3	WM (Conflict of methods)*	3	1
Impacts - Economy GOOD	5	3	WM Infrastructure - Compost Facility	3	3
Partnerships (importance of)	5	4	WM Infrastructure - Landfill (Need to end)*	3	2
Psychology - Cultural Norms	5	3	WM Infrastructure – WTE*	3	2
Research (importance of)	5	3	Advocacy (Importance of)*	2	2
Resource Management (Importance of)	5	5	Best Practices – Networking*	2	2
Stakeholders - Staff	5	4	Best Practices - Professional Development*	2	2
Technology (Importance of)	5	4	Collaboration (Importance of)*	2	2
WM Infrastructure - Landfills	5	5	Convenience*	2	2
Behaviors - Donate	4	3	Cost Effectiveness*	2	2
Behaviors - Recycling	4	3	Design – Signage*	2	2
Best Practices*	4	2	Economies*	2	2
Design - End of Life	4	4	Impacts - Economy BAD*	2	1
Design - Product	4	4	Impacts - Human Health*	2	2
Embodied Energy	4	3	Leadership*	2	2
Markets - Availability	4	4	Policy*	2	2
Policy - Enforcement	4	3	Preservation*	2	1
Policy - Incentives	4	4	Product Stewardship*	2	2
Policy - Legislation	4	3	Stakeholders – Citizens*	2	2
Psychology*	4	2	Stakeholders – Engineers*	2	1
Recycling	4	4	Stakeholders - Private WM*	2	2
Recycling (Challenges of)	4	3	Types of Waste – Industrial*	2	1
Stakeholders - Businesses	4	3	WM Infrastructure – Digestion*	2	2
Stakeholders - Institutions	4	3	WM Infrastructure – MRF*	2	2
Types of Waste - C&D	4	3	WM Infrastructure – Recyclers*	2	2
Types of Waste - Food Organics	4	4	WM Infrastructure – Transfer*	2	2
WM - Infrastructure (Importance of)	4	4			

Table 2 Concept items and frequencies across all participants 3CM maps (n=21) before and after conversion to a binary dataset.
*Concept items removed before cluster analysis (Freq. <3)

RQ 3: Are there key themes among stakeholder groups' conceptualizations of proper waste and materials management?

Based on the cluster analysis and summarized in the dendrogram (Fig. 3), the results reveal eight essential thematic clusters for the conception of appropriate waste and materials management (Fig. 4, 5):

- Design innovation
- Mechanisms of change
- Public investment
- Education
- Operations
- Strategic partnerships
- Individual action
- Extended producer responsibility

Frequency analysis also revealed the number of times individual concept items occurred in each thematic cluster, as seen in Figure 4. A composite map that integrates the dendrogram, thematic clusters, and sub-clusters is shown in Figure 5. Below, each of the 8 essential thematic clusters is described. The thematic clusters are presented alongside quotations from the qualitative interview section.

Design innovation. The *Design innovation* cluster emerged as a salient theme containing 5 concept items. A sub-cluster within this theme of items "Funding (Need for)," "Design—Packaging," and "Technology (Importance of)" exhibited similarities toward each other. "Design—Environmental" and "Markets," although grouped together, had a lowest threshold of similarity of any pairing in the entire set. One stakeholder in private waste explained the

relationship between, “Funding (Need for),” “Design—Packaging,” and “Technology (Importance of)” with an anecdote:

> *So aseptic packaging, which is your milk cartons, so that's pretty much - what is it? - 70% fiber and 30% polypropylene. There's some sort of a coating on it. And it can be recycled, but it's all about how it's collected and processed, right? And most of it never ends up there, but there was this huge force in the backside of it that said, 'We're recycling. Go out there. Offer them money." And that's coming from the manufacturer of it like, "Hey, we want our product to be recycled," and they do this whole push. And now it's kind of coming back because there was no market in China. […] So it's not really technically recyclable unless it goes to a hydro-pulper and so it's kind of an illusion that I think that the manufacturer or the design team wanted to create to say, "Yeah, it is recyclable”* –PW1

Mechanisms of change. The thematic cluster, *Mechanisms of change*, contained 9 concept items and two discrete sub-clusters. The first sub-cluster contained items “Politics,” “WM (Marketing),” “Stakeholders (Haulers),” and “Waste Management Infrastructure—Compost Facility.” The second sub-cluster contained items, “Communication,” “Education—Public Awareness,” “Community (Importance of),” “Psychology—Behavior change,” and “Research (Importance of),” and exhibited an overall high threshold of similarity compared against all other clusters across the dendrogram. A stakeholder from local government talked about the link between behavior change, communication, and education:

> *So I think that that's a challenge is changing behaviors and understanding that there's economics behind all of this. And for the longest time, waste management has kind of been viewed as a service to be provided. And so people kind of feel a sense of entitlement about that, right? I should be able to roll my bin down to the end of the driveway and put whatever the heck I wanted to it. […] We need to be able to say, "The consumers need to know it's the right thing to do. And the consumers need to know that there's a cost associated with it."* – LG1

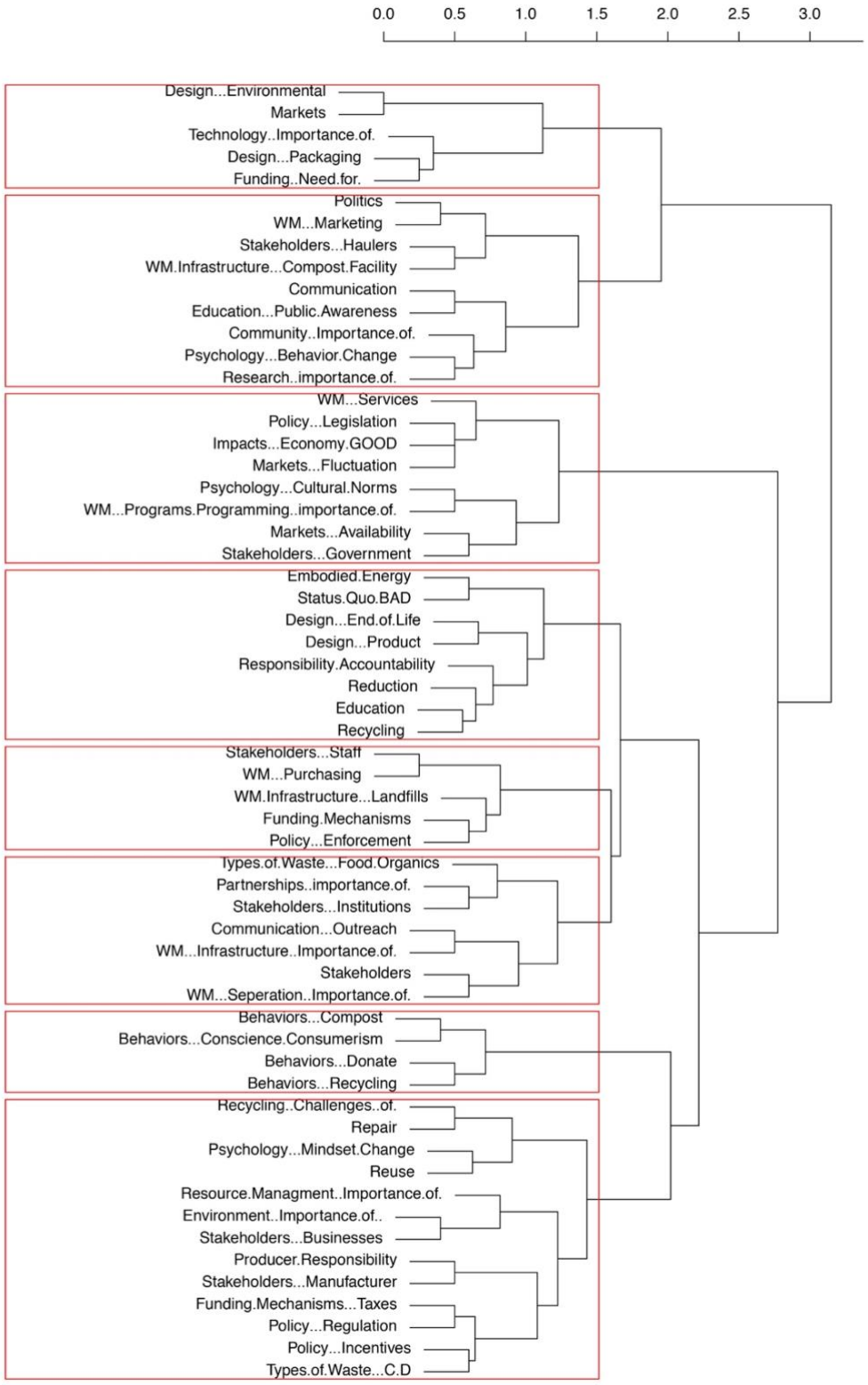

Figure 3 Dendrogram analysis for "good waste management" prompt, N=21.

DESIGN INNOVATION

14% Design—Environmental
14% Markets
19% Technology (Importance of)
14% Design—Packaging
19% Funding (Need for)

MECHANISMS OF CHANGE

14% Politics
24% WM—Marketing
14% Stakeholders—Haulers
14% WM Infrastructure—Compost Facility
14% Communication
14% Education—Public Awareness
19% Community (Importance of)
14% Psychology—Behavior Change
14% Research (Importance of)

PUBLIC INVESTMENT

14% WM—Services
14% Policy—Legislation
14% Impacts—Economy GOOD
14% Markets—Fluctuation
14% Psychology—Cultural Norms
14% WM—Programs/Programming (Importance of)
19% Markets—Availability
14% Stakeholders—Government

EDUCATION

14% Embodied Energy
19% Status Quo BAD
19% Design—End of Life
19% Design—Product
24% Responsibility/Accountability
38% Reduction
43% Education
19% Recycling

OPERATIONS

19% Stakeholders—Staff
14% WM—Purchasing
24% WM Infrastructure—Landfills
19% Funding Mechanisms
14% Policy—Enforcement

STRATEGIC PARTNERSHIPS

19% Types of Waste—Food Organics
19% Partnerships (Importance of)
14% Stakeholders—Institutions
24% Communication—Outreach
19% WM—Infrastructure (Importance of)
14% Stakeholders
19% WM—Separation (Importance of)

INDIVIDUAL ACTION

14% Behaviors—Compost
24% Behaviors—Conscience Consumerism
14% Behaviors—Donate
14% Behaviors—Recycling

EXTENDED PRODUCER RESPONSIBILITY

14% Recycling (Challenges of)
14% Repair
19% Psychology—Mindset Change
33% Reuse
24% Resource Management (Importance of)
24% Environment (Importance of)
14% Stakeholders—Businesses
29% Producer Responsibility
14% Stakeholders—Manufacturer
14% Funding Mechanisms—Taxes
29% Policy—Regulation
19% Policy—Incentives
14% Types of Waste—C&D

Figure 4 Cluster analysis solution for "good waste management" prompt, N=21. Numbers reflect percentages of participants who selected that item

Public investment. The *Public investment* cluster contained 8 items and two discrete sub-clusters. The first sub-cluster contained items "Waste Management—Services," "Policy—Legislation," "Impacts—Economy GOOD," and "Markets—Fluctuation." The second sub-cluster contained items, "Psychology—Cultural Norms," "Waste Management--Programs/Programming (Importance of)," "Markets—Availability," and "Stakeholders—Government." Both sub-clusters exhibited relatively high similarity thresholds. Quotations from two stakeholders connect many of these concept items together:

> *[I]n order for anything of significance to change we need policy to change, so that it really comes down to who we're voting in and what we're demanding in policy. But it's also a cultural change. We're going to have to have a change of values and we have--those sort of things have to come about with very big paradigm shifts. I mean, prior to World War II it was a cultural value to be frugal. It was considered patriotic to be frugal. It was considered patriotic to repair.* –CRO8

> *And we just don't have money to do that. So, of course, if we had better equipment, then we may be able to capture more things. And then, the other thing is recycling commodity markets right now. The impacts of China, the impacts of the global market is a big challenge for all that. Because we put so much effort in trying to divert material away from a disposal method into something else. And the opportunity is very limited in where that material can go. It really upsets the entire system as a whole. So, supply and demand gets turned upside down.* –LG3

Education. The *Education* thematic cluster contained 8 items and featured three sub clusters. The first sub-cluster was a pair of items, "Embodied Energy" and "Status Quo BAD." And the second sub-cluster linked "Design—End of Life" together with "Design—Product." Finally, the third sub-cluster contained items, "Responsibility/Accountability," "Reduction," "Education," and "Recycling." This final sub-cluster contained two out of the top five most frequent items. All three sub-clusters exhibited a high threshold of similarity. Stakeholders outlined the elements of this thematic cluster with the following quotations:

> *So it's manufacturing, and then it's the marketing department down here. And then it's the consumer, right? The consumer is never held accountable for just buying stuff that's just*

> *thrown away all the time. They don't care. We make it easy to buy, which is okay, but then there's no accountability of making sure that it lasts, and I think that's both on the manufacturer and the consumer.* – PW1

> *I would say challenges include the education or providing information to people on all levels like household, individual level as well as the business level of what food is still good and then, what can be donated. And so that's probably the biggest hurdle we have.* – CRO3

> *[O]ur approach is if you empower kids and adults through education and behavior change they will not only change their behavior positively but they will also teach each other and hold each other accountable.* – CRO4

Operations. The *Operations* thematic cluster contained 5 items and 1 distinct sub cluster. Although "Stakeholders—Staff" and "WM—Purchasing" were paired together, the pairing did not exhibit a high similarity frequency. The distinct sub-cluster that exhibited a high similarity threshold within strategic partnerships contained the following items: "Waste Management Infrastructure—Landfills," "Funding Mechanisms," and "Policy—Enforcement." One stakeholder working in local government outlined the importance and challenges of the *Operations* thematic cluster:

> *The key challenge is funding and market stability/longevity. Those are the two keys. And they're not going hand-in-hand on the commodity or the resource side. And often they're not going hand-in-hand on the landfill side. As everybody competes, competition sometimes creates false pricing structures, so in some areas, landfill has gotten cheap because they subsidized an industry on something else. We use the landfill or the waste industry to subsidize recycling. When recycling is really good, sometimes we can use those profits to subsidize the collection industry or for the landfill the private companies that own the landfill and the collection and the-- so they have multiple pieces of the pie to subsidize one arm of the industry.* –LG4

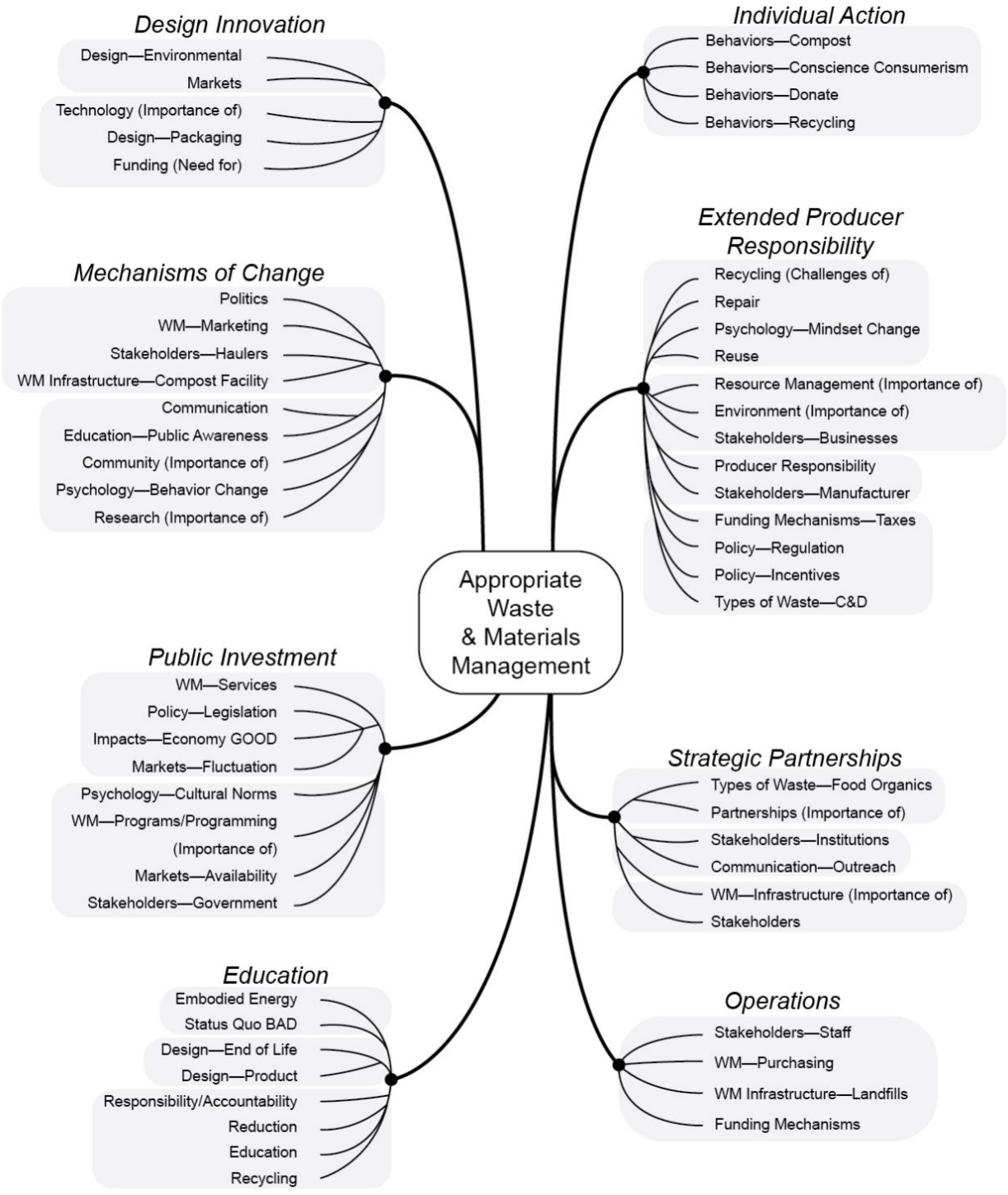

Figure 5 Composite map. Hierarchical clustering results based on twenty-one stakeholders in waste and materials management.
Concept items were chosen by at least 14% of participants. Thematic clusters are italicized; thematic sub-clusters are represented by grey rectangles.

Strategic partnerships. The thematic cluster, *Strategic partnerships*, contained 7 items and 3 sub-clusters. The first sub-cluster contained "Types of Waste (Food Organics)," "Partnerships (Importance of)," "Stakeholders—Institutions." The second sub-cluster contained "Communication—outreach" and "Waste management—Infrastructure (Importance of)." The final cluster contained items, "Stakeholders", and "WM—Separation (Importance of)." The importance of partnerships was brought up during multiple interviews:

> *So as local government, I feel like in some of what we do is try to kind of like connect those pieces where, for instance, we may have a MRF that creates glass through a crusher. The glass is so small – spec— that no mill wants it. But in [redacted] County, we know that we have this burgeoning sandblasting company and that type of material is exactly what they want as like an input to the process. So to be able to say, "Wait, that's a waste to you, but that's their starting product. They need that."* – LG1

> *And they can lead as an example to other universities. For a business like us since we've had [redacted] for so long, and we've come so far with them in both them educating us, us educating them, that we can use them as examples when we go to other schools and municipalities* –PW2

Individual action. The thematic cluster of *Individual action* contained four items, "Behaviors—Compost," "Behaviors—Conscience Consumerism," "Behaviors—Donate," and "Behaviors—Recycling." This thematic cluster was reiterated by a stakeholder in local government:

> *Like reduce, reuse, recycle. And now they're saying, "Well, one of those R's should be refused." So not only are you reducing it, but refuse it, to begin with. And we've seen that kind of lately bear some fruit in terms of like the way people feel about plastic straws. Plastic straws, and plastic cutlery being able to say like, "No. I just don't even need it. I'll put it in the bag or don't put it in my drink. I don't need it."* – LG1

Extended producer responsibility. The last thematic cluster, *Extended producer responsibility* comprised 13 items and 4 sub-clusters. The first sub-cluster encompassed the items, "Recycling (Challenges of)," "Repair," "Psychology—Mindset change," and "Reuse."

The second sub-cluster contained items "Resources Management (Importance of)," "Environment (Importance of)," and "Stakeholders—Businesses." The third sub-cluster was a pair of items, "Producer Responsibility" and "Stakeholders—Manufacturer." Finally, the last sub-cluster contained items "Funding Mechanisms—Taxes," "Policy—Regulation," "Policy—Incentives," and "Types of Waste—Construction & Debris." Portions of this thematic cluster were brought up by a stakeholder working at a community reuse organization:

> *So again, the manufacturers are only going to follow the regulations to the minimum. As far as I'm concerned, they might make a little noise when they get caught doing something, but they don't really-- the community benefit doesn't add into the equation. And that's where waste management falls in. It's a community benefit, like preservation.*
> - CRO6

RQ 4A: Are there key differences and/or similarities among stakeholder groups' conceptualizations of proper waste and materials management?

Table 3 shows the percentage of participants in each stakeholder group (i.e., local government, community reuse organizations, private waste) that included at least one item from the thematic cluster groups in their concept maps. In other words, Table 3 provides a summary of how salient each thematic cluster was to the different stakeholder groups.

The results suggest general consensus for four out of the eight thematic cluster groups (*extended producer responsibility, individual action, strategic partnerships,* and *public investment*) between the local government and community reuse stakeholders. For all of these themes, local government and community reuse organizations groups only differed by 12% or less, indicated some consensus.

The results also suggest disagreement over the remaining four thematic clusters (*design innovation, mechanisms of change, education,* and *operations*). Regarding *design innovation,* 40% of local government participants mentioned at least 1 item from the cluster compared to

13% of community reuse organization participants. Concerning *mechanisms of change,* 60% of local government participants mentioned at least 1 item from the cluster compared to 38% of community reuse organizations. Similarly, 50% of local government participants mentioned at least 1 item from the *operations* cluster compared to 13% of community reuse organizations. Finally, 100% of community reuse organization participants mentioned at least 1 item from the *education* thematic cluster in comparison to 60% of local government participants.

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
Local government	10	40%	60%	50%	60%	50%	70%	30%	60%
Community reuse organization	8	13%	38%	38%	100%	13%	63%	25%	75%
Private waste*	3	33%	0%	33%	67%	100%	0.30%	66%	30%

Table 3 Comparison of major waste management themes, by stakeholder group.
Numbers reflect percentages of participants who selected at least one item from the thematic cluster
*Stakeholder group removed from further analysis

RQ 4B: Does participation in pro-environmental behaviors predict key differences in the content of participants' conceptual maps of proper waste and materials management?

A summary of participants' PEB subdomain scores is summarized in Table 4.

Participants' mean scores in each PEB subdomain is summarized in Table 4 and are as follows: *conservation lifestyle* (M = 4.59), *land stewardship* (M = 2.82), *social environmentalism* (M = 4.17), and *environmental citizenship* (M=3.62). *Conservation lifestyle* exhibited a low standard deviation (0.35) and variance (0.12) in comparison to the three other subdomains, *land*

stewardship (SD = 0.83, $\sigma^2 = 0.69$), *social environmentalism* (SD = 0.94, $\sigma^2 = 0.94$), and *environmental citizenship* (SD = 0.95, $\sigma^2 = 0.91$). Finally, *conservation lifestyle* and *land stewardship* exhibited low Cronbach's alpha values (0.33 and 0.51, respectively) in comparison to *social environmentalism* and *environmental citizenship* (0.89 and 0.91, respectively).

Behavior subdomain	# of items	M*	SD	σ^2	Cronbach's alpha
Conservation lifestyle	3	4.59	0.35	0.12	0.33
Land stewardship	3	2.82	0.83	0.69	0.51
Social environmentalism	3	4.17	0.94	0.89	0.78
Environmental citizenship	4	3.62	0.95	0.91	0.86

Table 4 Summary of the four pro-environmental behavior (PEB) subdomains (n=21).
*Participation Frequency Scale: 1 = Never, 2 = Rarely, 3 = Occasionally, 4 = Often, 5 = Very often

We used the *land stewardship, social environmentalism* and *environmental citizenship* subdomains to establish additional participant groupings (beyond our predetermined stakeholder designations) because they exhibited both high variance and α values. The *conservation lifestyle* subdomain was not used because of its low variance—all participants scored relatively similar on those subdomain items—and low α value. Of the subdomains analyzed, we split each into two cohorts along their mean values, *land stewardship* (2.82), *social environmentalism* (4.17) and *environmental citizenship* (M=3.62).

A comparison of major themes by the *land stewardship* PEB subdomain was conducted. Table 5 shows the percentage of participants by their participant in the land stewardship PEB subdomain that included at least one item from the thematic cluster groups in their concept maps. The participants were split into two groups along scale's mean value (M=2.82) to create a high-scoring *land stewardship* group (LS High; M=3.42) and a low-scoring *land stewardship* group (LS Low; M=2.17). The results suggest general consensus among three out of the eight thematic

clusters: *public investment*, *education*, and *individual action*; with these groups differing by less than 6%. However, the high-scoring and low-scoring groups differed in their inclusion of the following cluster themes, *design innovation (*Δ = 22%), *mechanisms of change (*Δ = 15%), operations *(*Δ = 15%), strategic partnerships *(*Δ = 15%), and extended producer responsibility *(*Δ = 45%).

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
LS High (M=3.42)	11	18%	55%	45%	82%	55%	55%	36 %	45%
LS Low (M=2.17)	10	40%	40%	40%	80%	40%	70%	30%	90%
Δ		22%	15%	5%	2%	15%	15%	6%	45%

Table 5 Comparison of major waste management themes, by land stewardship PEB subdomain. Numbers reflect percentages of participants who selected at least one item from the thematic cluster

A comparison of major themes by the *social environmentalism* PEB subdomain was also conducted. Table 6 shows the percentage of participants by their participation in the *social environmentalism* PEB subdomain that included at least one item from the thematic cluster groups in their concept maps. The participants were split into two cohorts along the scale's mean value (2.82) to create a high-scoring *social environmentalism* group (SE High; M=4.83) and a low-scoring *social environmentalism* group (SE Low; M=3.30). The results suggest consensus among two out of the eight thematic clusters: *strategic partnerships* and *individual action*; with these groups differing by less than 9%. However, the high-scoring and low-scoring groups differed in their inclusion of the following cluster themes, *design innovation* (Δ = 27%),

mechanisms of change (Δ = 25%), *public investment* (Δ = 23%), *education (*Δ = 14%), *operations* (Δ = 17%), and extended producer responsibility *(*Δ = 20%).

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
SE High (M=4.83)	12	17%	58%	33%	75%	50%	58%	33%	58%
SE Low (M=3.30)	9	44%	33%	56%	89%	33%	67%	25%	78%
Δ		27%	25%	23%	14%	17%	9%	8%	20%

Table 6 Comparison of major waste management themes, by social environmentalism PEB subdomain.
Numbers reflect percentages of participants who selected at least one item from the thematic cluster

A comparison of major themes by the *environmental citizenship* PEB subdomain was also conducted. Table 7 shows the percentage of participants by their participant in the *environmental citizenship* PEB subdomain that included at least one item from the thematic cluster groups in their concept maps. The participants were split into two cohorts along scale's mean value (3.62) to create a high-scoring *environmental citizenship* group (EC High; Mean=4.29) and a low-scoring *environmental citizenship* group (SE Low; Mean=2.72). The results suggest general consensus among two out of the eight thematic clusters: *public investment* and *extended producer responsibility*; with these groups differing by less than 2%. However, the high-scoring and low-scoring groups differed in their inclusion of the following cluster themes, *design innovation* (Δ = 27%), *mechanisms of change* (Δ = 25%), *education* (Δ = 25%), *operations (*Δ = 34%), *strategic partnerships* (Δ = 18%), and individual action *(*Δ = 19%).

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
EC High (M=4.29)	12	17%	58%	42%	92%	33%	50%	25%	67%
EC Low (M=2.72)	9	44%	33%	44%	67%	67%	78%	44%	67%
Δ		27%	25%	2%	25%	34%	28%	19%	0%

Table 7 Comparison of major waste management themes, by environmental citizenship PEB subdomain.
Numbers reflect percentages of participants who selected at least one item from the thematic cluster

RQ4C: Do demographics predict key differences between participants' conceptualizations of proper waste and materials management?

Table 8 shows the percentage of participants by gender that included at least one item from the thematic cluster groups in their concept maps. The results suggest consensus for six out of the eight thematic clusters: *design innovation*, *mechanisms of change*, *education*, *operations*, *strategic partnerships*, and *extended producer responsibility*; with these theme clusters males and females differed by 13% or less. However, the female versus male stakeholder group differed in their inclusions of the *public investment* and *operation* cluster themes. Regarding *public investment*, 33% of females included at least one item from the theme in their maps in comparison to 55% of males. Regarding *individual action*, 42% of females included at least one item from the them in the maps, in comparison to 22% of males.

A comparison of major themes by work experience was also conducted. Table 9 shows the percentage of that two groups in the field of waste and materials management included at least one item from the thematic cluster groups in their concept maps. The cohort was split into

two comparison groups according to the median number of job years (13 years). The results suggest consensus for four out of the eight thematic clusters: *education, operations, strategic*

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
Female	12	25%	50%	33%	83%	42%	58%	42%	58%
Male	9	22%	44%	55%	78%	55%	67%	22%	67%
Δ		3%	6%	22%	5%	13%	9%	20%	9%

Table 8 Comparison of major waste management themes, by gender.
Numbers reflect percentages of participants who selected at least one item from the thematic cluster

partnerships, and *extended producer responsibility*; with these groups, both groups differed by 8% or less. However, participants with more than 13 years job experience versus participants with less than 13 years job experience differed in their inclusions of the cluster themes, *design innovation (*Δ = 16%), *mechanisms of change (*Δ = 20%), *public investment (*Δ = 14%), and *individual action (*Δ = 14%).

Stakeholder group	N	Design innovation	Mechanisms of change	Public Investment	Education	Operations	Strategic partnerships	Individual action	EPR
Job Years > 13	10	20%	60%	50%	70%	30%	60%	20%	70%
Job Years < 13	11	36%	40%	36%	82%	36%	54%	36%	63%
Δ		16%	20%	14%	12%	6%	6%	16%	7%

Table 9 Comparison of major waste management themes, by job years in waste and materials management.
Numbers reflect percentages of participants who selected at least one item from the thematic cluster

RQ5: Who are the stakeholders in waste and materials management, according to the participants?

Table 10 shows the coded items and their frequencies. The eight most-mentioned coded items were: Everyone (7), Manufacturers (6), Waste Management – Private (5), Consumers (4), Government (4), Government – Municipalities (4), Individuals (4), and Waste Management – Public (4).

Item	Frequency (Raw)
Everyone	7
Manufacturers	6
Waste Management - Private	5
Consumers	4
Government	4
Government - Municipalities	4
Individuals	4
Waste Management - Public	4
Businesses - Institutions	3
Government - Policymakers	3
Haulers	3
MRFs	3
Businesses	2
Businesses - Local	2
Community	2
Environmental Activists	2
Manufacturers - Energy	2
Recyclers	2
Advertisers	1
Businesses - Industrial	1
Businesses - Non-Profits	1
Buyers	1
Government - County	1
Government - State	1
Regulators	1
Residents	1
Scientific Community	1

Table 10 Coded items and frequencies, across participants (n=20), for "Who are the stakeholders in waste and materials management?".

RQ6: What are the salient issues facing waste and materials management today?

Table 11 shows the coded items and their frequencies. The top three most-mentioned coded items were: Cultural change (5), Education (5), and Funding (5); Communication (3) and Program Development (3); Behavior Change (2).

Item	Frequency (Raw)
Cultural Change	5
Education	5
Funding	5
Communication	3
Program Development	3
Behavior Change	2
Capitalism	1
Convenience	1
Cooperation	1
Distribution Network	1
Education - Awareness	1
Education - Impacts	1
Education - True Cost	1
Food Waste	1
Markets - Stable	1
Reducing Contamination	1
Waste Management (Unintended Consequences)	1

Table 11 Coded items and frequencies across all participants (n=20) for "What are the biggest challenges facing waste and materials management, today?"

CHAPTER 4

Discussion

Summary of Findings

This study's primary objective was to contribute to the reevaluation of the range of research being done on the topic of waste from the perspective of the field of environment and behavior. We pursued this objective by engaging stakeholders in the field of waste and materials management, collating their perspectives on appropriate waste and materials management, and analyzing these outputs using a range of methods. While our research only engaged a handful of stakeholders in a vast and complex waste system, we nonetheless collected a rich amount of data to analyze. The themes and insights gained from this exploratory research provide exciting directions and clarity for future environment and behavior research concerned with waste.

Education. The concept item "Education" was the most frequently mentioned topic in both a raw and binary accounting of the participants' 3CM maps. Education was also one of the top three most salient issues raised by stakeholders during the interview. The salience of education to stakeholders is mirrored by literature on household waste behaviors that identifies information and knowledge as important psychological antecedents. Indeed, the majority of interventional studies on recycling behaviors (63%) have considered information and knowledge as factors in their study design (Varatto & Spagnolli, 2017). However, it is important to note that the same research acknowledges the pathway from knowledge to behavior and action is complicated by a range of other psychological, social, demographic, and environmental factors (Varatoo & Spagnolli, 2017), suggesting ultimately that education is not a panacea.

An analysis of the *Education* thematic cluster and its three sub-clusters suggests an important perspective shifts in the field of waste and materials management. For example, the

sub-cluster containing “Embodied Energy” and “Status Quo BAD” in conjunction with the sub-cluster containing “Responsibility/Accountability,” “Reduction,” “Education,” and “Recycling” can be seen as a recognition of the need for LCA methodologies over standard diversion metrics, or impact-based metrics over weight-based metrics (Leif, 2018). The third sub-cluster of “Design—End of Life” and “Design—Product” again points to a broadening of perspective in that it identifies design as a key intervention point upstream from consumers. Finally, the thematic sub-clusters and their contents reflect the EPA’s own waste management hierarchy (Figure 6) and its stated priorities. Notably, the connection between the concept items “education” and “reduction” revealed by cluster analysis is encouraging given that “reduction” was the second most mentioned item in the 3CM maps and is the top priority of the waste management hierarchy diagram.

Figure 6 Waste Management Hierarchy Diagram (EPA, n.d.c)

Extended producer responsibility. From the binary dataset, “Policy – Regulation” and “Producer Responsibility” were the fourth and fifth most mentioned concept items in the 3CM

maps which suggests the importance of EPR to the stakeholders that participated in this study. An analysis of the thematic cluster *extended producer responsibility* and its constituent elements also reveals the cohesiveness of the EPR concept to stakeholders. The entire cluster communicates broad elements of the EPR project by outlining the concept's stakeholders (e.g., "Stakeholders—Manufacturer," "Stakeholders—Businesses"), underlying motivations (e.g., "Resources Management (Importance of) ," "Environment (Importance of) ," "Recycling (Challenges of)"), and mechanisms for achieving EPR (e.g., "Funding Mechanisms—Taxes ," "Policy—Regulation ," "Policy—Incentives ," and "Psychology—Mindset Change"). The cohesion between concept items within each of the four sub-clusters is notable (e.g., "producer" responsibility" and "Stakeholders—Manufacturer"). In sum, the thematic cluster's cohesiveness in terms of the grouping together of apt terms as well as the frequency of the cluster's elements suggest the importance of EPR policy efforts (Leonard, 2010; Miller, 2019).

Strategic partnerships and operations. The salience of the thematic clusters *strategic partnerships* and *operations* brought attention to important aspects of waste management that might often be overlooked. For example, the item "WM—Purchasing" is a reminder that recycling systems rely on commodity buyers to function. The item "WM—Separation (Importance of)" also points to the importance of separation technologies and infrastructure (e.g., MRFs) in the greater waste system. Finally, the sub-cluster containing the items "Types of Waste (Food Organics)," "Partnerships (Importance of)," "Stakeholders—Institutions" points to two relevant issues. The first issue is the understanding that institutions also produce waste and that strategic partnerships with these entities is an important goal for planners and waste managers. The second issue is the importance of addressing food waste which has been highlighted as a priority in New York State (Rosengren, 2019).

Stakeholder definitions. This study has contributed to an ongoing discussion regarding the stakeholders in waste and materials management. Who is implicated in waste and materials management systems? And who should bear the responsibility of waste's impact? Although this study relied on MacBride's (2012b) delineation of stakeholder groups, participant responses to the stakeholder interview question reaffirm MacBride's categorizations.

Salient issues. In a similar way, a thematic analysis of the most salient issues facing waste and materials management today point to a wide range of topics. While the issues like Education, Communication, and Behavior Change relate primarily to the individual, items like Funding and Program Development relate to waste managers, both public and private, and community reuse organizations.

Levers for change. The eight themes revealed by cluster analysis (Fig. 5, 6), as well as the stakeholder definitions and salient issues revealed by thematic analysis, suggest a range of important levers for change. Crucially, these thematic clusters (and their component sub-clusters and concept items) imply different stakeholders and different levers by which appropriate waste and materials management or positive change can be achieved. For example, the *Individual action* and *Education* themes relate to individual citizens; *Extended Producer Responsibility* and *Design Innovation,* can be seen to relate to manufacturers and policy; *Waste Management* can be seen as relating to public or government stakeholders; and finally, *Strategic Partnerships, Operations, Mechanisms of Change* can be seen as relating to waste managers, non-profits, institutions, and collective action. The diversity of possible change-agents is reinforced by a thematic analysis of the interview questions which implicated a range of stakeholders and issues.

This plurality, in both the perceived levers of change and implicated stakeholders, reinforces calls to decenter certain individual behaviors and behavioral change frameworks from

the research agenda (MacBride, 2012b, Liboiron, 2014). Consequently, the "levers" framework aligns well with existing ecological systems models (Sallis & Owens, 2015). As Sallis and Owens (2015) write, "a central proposition of ecological models is that it usually takes the combination of both individual-level and environmental- and policy-level interventions to achieve substantial positive changes" (p. 44).

Thematic salience by groups. Finally, comparing the salience of thematic clusters across different groupings (e.g., stakeholder group, PEB participation, gender, work experience) provides preliminary insights for future research. While these results rely on a small sample of participants, we hope the ensuing discussion will spur further investigation into these topics.

Regarding the comparison between stakeholder groups (i.e., local government and community reuse organization), it is reasonable that the *operations* cluster was more salient to local government participants over community reuse organization participants since the cluster contained items more related to management. The difference in theme inclusion for the *education* thematic cluster between participants working at community reuse organizations versus participants working in local government was intriguing and warrants additional research.

Comparing the thematic salience according to participants' engagement in PEBs also provided insights. Regarding the *land stewardship* PEB subdomain, which consisted of activities like wildlife advocacy or participating in wildlife studies, only 45% of the participants who scored high on the *land stewardship* subdomain included the *extended producer responsibility* thematic sub-cluster, compared to participants who scored low on the *land stewardship* subdomain, of which 90% of participants included the EPR theme. A comparison between participants who scored high and low on the *social environmentalism* PEB subdomain, which consisted of behaviors like participating in local environmental groups, revealed consensus in

only two out of the eight thematic clusters. However, the difference between the two groups and the remaining six thematic clusters only ranged between 14% and 27%. Regarding *design innovation,* which had the highest change, 17% of high-scorers in the social environmentalism subscale included *design innovation*, compared to 44% of low-scorers. Both cases (i.e., the *land stewardship* subdomain with *EPR,* the *social environmentalism* subdomain with *design innovation*) suggest a negative relationship between participation in PEBs and the salience of "upstream" waste solutions like EPR and design innovation.

Finally, a comparison of thematic salience according to demographic characteristics was conducted and revealed few differences between gender and age groups. A comparison between genders and their thematic inclusion revealed a considerable consistency between males and females. Of the eight thematic clusters, six clusters differed by 13% inclusion or less; the remaining two clusters only differed by 22% (*waste management*) and 20% (*individual action*). Similarly, a comparison between participants with high and low job experience exhibited cohesion between four out of eight thematic clusters; the remaining four thematic clusters only differed between 20% or less.

Study Strengths

This study design had many strengths. The 3CM research method can be used as a powerful tool for both qualitative and quantitative analysis and produces a rich amount of data for investigation. The 3CM has been used in environment and behavior research for a variety of topics (Austin, 1994; Kearney & Bradley, 1998; Kearney et al., 1999; Wells, 2005; Byrch et al., 2007; Guckian et al., 2018; Hamilton et al., 2018). To our knowledge this is the first use of 3CM to research waste and waste issues, a popular topic within the field of environment and behavior. Although the research questions of this study were exploratory in their intent, some of the

analysis aligns with existing literature on current waste solutions (e.g., waste management hierarchy EPR). The study's measures included a valid and reliable scale of pro-environmental behaviors that exhibited Cronbach's alpha values between 0.638 and 0.839 for its four subdomains (Larson, et al., 2015). Our study's convergent mixed method design (i.e., 3CM tool plus interview questions) helped against mono-method bias. Finally, by engaging participants specifically within the context of New York state, the study bolstered the consistency of the sample.

Limitations

This study also had limitations. We will discuss the limitations below organized around five types of validity: statistical, internal, external, construct, and observer. Despite these limitations, we believe this exploratory research study generated a range of insights and new directions of study for the fields of environment and behavior and waste and materials management.

Statistical validity. The small sample (n=21) results in low statistical power in this study, which is a foremost limitation particularly with respect to the between-groups comparisons that were made. The cluster analysis and thematic content analysis could have also been influenced by the small sample. A larger sample might have revealed more cohesive thematic clusters and differences in thematic salience across groups.

Internal validity. Our use of a non-experimental research design—it did not have a control group, manipulated independent variable, or random assignment—means that we cannot conclude causal relationships between the variables and factors we studied.

External validity. There were number of threats to the external validity of this study. Our reliance on snowball sampling to identify and secure participants might have contributed to

selection bias and volunteer bias. Therefore, the pool of participants we studied might not adequately represent the full range of waste and materials management stakeholders in the upstate New York region. Relatedly, since waste issues are first and foremost local issues, the results of these studies might not be generalizable to other regions beyond New York State. Finally, history effects might affect the external validity of this study. Our study conducted interviews and collected data between April 2018 and September 2018. This period, for example, coincided with the events of China's national sword policy which could have uniquely affected the results of this study and its generalizability outside of the context of national sword.

Construct validity. There were also a number of threats to the construct validity of this study. Because the study was conducted in-person, there is a possibility that experimenter effects and expectancy might have affected the data collected. That is, physical characteristics of the researcher might have affected how each study protocol unfolded. Additionally, the researcher's unconscious or conscious expectancies of the participants (e.g., job title, stakeholder group) might have unintentionally affected participants' responses.

Our broad research questions might have also affected the construct validity of our study. For example, our study did not specify a type of waste (e.g., municipal solid waste, industrial solid waste) for participants. Therefore, participants might not have been conceptualizing both waste and its subsequent issues in the same way. Finally, time might have been an issue affecting construct validity. Although, the researcher tried to build in enough time for interviews, participants were often interviewed in their place of work or only had a certain amount of time to devote to the study protocol.

Observer validity. Lastly, a range of threats to observer validity must be discussed. Given that we conducted an open-ended 3CM study, there are a variety of ways that the final

coded items and 3CM maps might have differed from the participants' original maps or intended meaning. For example, while the coding process was a necessary step for quantitative analysis, abbreviation might have led to a loss of detail from the original items. For example, the item "Jobs" was ultimately coded as "Impacts – Economy GOOD" which might not have been the original participant's intended meaning. The researcher's errors of commission and theoretical bias might have influenced the coding process as well. In other words, the researchers might have introduced their own biases through the coding process and subsequent analysis of the coded results. Finally, since there was a considerable amount of coding work to be done, the coding processes might have been influenced by contamination and observer drift (i.e., the meaning of codes changed over time).

Implications and Potential Applications

This study represents a compelling foundation for new environment and behavior research on waste. In that sense, researchers can use this study to develop a wide range research questions to study more specific hypothesis. This study also serves as original research on stakeholder perspectives on appropriate waste and materials management. In that light, stakeholders in waste management (e.g., managers, directors, policymakers, planners) can use this study in a variety of ways. Stakeholders can evaluate the thematic clusters and other outputs in comparison to their own work or as a means of justification for new programs (e.g., EPR) or collaborations (e.g., strategic partnerships).

Future Research

Future research can build upon this study. A closed or hybrid 3CM study can be conducted, using the codes developed in this study, which would avoid a lengthy pre-testing process and validity threats that stem from the coding process. A study of this kind could

theoretically reach more participants and therefore have greater statistical power if it is administered via mail or electronically, which was achieved in a 3CM study on green citizenship (Guckian et al., 2018). Related to waste, this study also suggests a wide range of stakeholder groups that can potentially be targeted for research. Another study might research other stakeholder groups in the waste management system (e.g., manufacturers, consumers) similarly against demographic factors or other psychological factors.

Beyond the study of waste, the refinement and expansion the 3CM tool would be a worthwhile research endeavor. For example, is there a standardized and efficient way to warm up participants to the 3CM task? Over the course of this project, we noticed a wide range of willingness or openness to the 3CM process in the participants. A study could develop a standardized introductory prompt to help participants work up to the full 3CM process. Additionally, the 3CM concept map does not incorporate a hierarchy of importance into its maps. Over the course of administering the 3CM study, we observed multiple participants attempt to portray a hierarchy of importance in their maps which was subsequently lost in the coding and analyzing process. If a factor of importance can be codified into the 3CM process, that would allow for even more nuanced analysis.

Conclusion

In conclusion, we studied the wicked nature of waste by engaging stakeholders in New York State and collating their perspectives on appropriate waste and materials management. Using a mix of qualitative and quantitative techniques we gathered a rich amount of data to answer an array of exploratory research questions. It is our hope that this research both reaffirms existing work being done in the field and suggests promising future directions for study. As Rittel and Webber (1973) contend, the goal of the wicked planning problem framing is not to find an objective or ultimate truth, but rather, to "improve some characteristics of the world where people live" (p. 167).

REFERENCES

Andrady, A. L. (2015). *Plastics and environmental sustainability*. Hoboken, NJ: John Wiley & Sons, Inc. doi.org/10.1002/9781119009405

Arbuthnot, J. (1974). Environmental knowledge and recycling behavior as a function of attitudes and personality characteristics. *Proceedings of the Division of Personality and SocietyPsychology*, *1*(1), 119–121. doi.org/10.1177/014616727400100140

Austin, D. E. (1994). *Exploring perceptions of hazardous waste facility proposals in Indian country: An application of the active symbol cognitive map model* (Doctoral dissertation, University of Michigan). Retrieved from ProQuest Dissertations & Theses Global. (OrderNo. 9423137)

Axon, S. (2017). "Keeping the ball rolling": Addressing the enablers of, and barriers to, sustainable lifestyles. *Journal of Environmental Psychology*, 52, 11–25. doi.org/10.1016/j.jenvp.2017.05.002

Barnes, D. K. A., Galgani, F., Thompson, R. C., Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 1985–1998. doi.org/10.1098/rstb.2008.0205

Barr, S., & Gilg, A. (2006). Sustainable lifestyles: Framing environmental action in and around the home. *Geoforum*, 37(6), 906–920. doi.org/10.1016/j.geoforum.2006.05.002

Bauer, P. (2015). Great pacific garbage patch. In *Encyclopedia Britannica*. Retrieved from http://www. academic-eb-com

Black, R. (2012). Clean water act. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 126-127). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n52

Brenton, B. & Galvin, A. (2012). Environmental justice. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 231-232). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n93

Byrch, C., Kearins, K., Milne, M., & Morgan, R. (2007). Sustainable "what"? A cognitive approach to understanding sustainable development. *Qualitative Research in Accounting & Management*, 4(1), 26–52. doi.org/10.1108/11766090710732497

Church, J. (2012). Ocean disposal. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 619-623). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n238

Clavreul, J., Bakas, I., Gentil, E., Niero, M., Hauschild, M. Z., Bernstad, A., … Christensen, T. H. (2014). Review of LCA studies of solid waste management systems – Part II: Methodological guidance for a better practice. *Waste Management*, 34(3), 589–606. doi.org/10.1016/j.wasman.2013.12.004

Corkery, M. (2019, March 16). As costs skyrocket, more U.S. cities stop recycling. *The New York Times*. Retrieved from https://www.nytimes.com

Cusack, C. (2012). Comprehensive environmental response, compensation, and liability act (CERCLA/superfund). In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 141-141). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n59

D'Souza, K. (2018, July 20). Way beyond recycling: How some Bay Area families are trying to get to zero waste. *The Mercury News*. Retrieved from https://www.mercurynews.com

Dewitt, D. (2015, May 15). Duke energy pleads guilty, agrees to $102 million fine. *North Carolina Public Radio*. Retrieved from https://www.wunc.org/post/duke-energy-pleads-guilty-agrees-102-million-fine

Duffy, S., & Verges, M. (2009). It matters a hole lot: Perceptual affordances of waste containers influence recycling compliance. *Environment and Behavior*, 41(5), 741–749. doi.org/10.1177/0013916508323737

Elliot, B. (2015, June 23). Latest EPA figures highlight effect of evolving ton. *Resource Recycling*. Retrieved from https://resource-recycling.com/recycling/2015/06/23/latest-epa-figures-highlight-effect-of-evolving-ton/

Farina, B. & Zimring, C. (2012). History of consumption and waste, U.S., 1950–present. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 365-370). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n146

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(July), 25–29, doi: 10.1126/sciadv.1700782

Geyer, R., Kuczenski, B., Zink, T., & Henderson, A. (2015). Common misconceptions about recycling. *Journal of Industrial Ecology*, 20(5), 1010–1017. doi.org/10.1111/jiec.12355

Geyn, I. (2019, March 1). MRF operators come out in force against New York bottle bill expansion. *Waste Dive*. Retrieved from https://www.wastedive.com

Gifford, R. (2014). Environmental psychology matters. *Annual Review of Psychology*, (65), 541 579. doi.org/10.1146/annurev-psych-010213-115048

Gill, G. N. (2016). Electronic waste. In *Encyclopedia Britannica*. Retrieved from http://www. academic-eb-com

Gille, Z. (2007). Toward a social theory of waste. *From the cult of waste to the trash heap of history: The politics of waste in socialist and postsocialist Hungary* (pp. 11-37). Bloomington, IN: Indiana University Press

Grover, V. (2012). Public health. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 710-713). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n269

Guckian, M., Hamilton, E., & De Young, R. (2018). Cognitive mapping as participatory engagement in social science research on sustainability. In *Handbook of Sustainability and Social Science Research* (pp. 337–352). Springer International Publishing. doi.org/10.1007/978-3-319-67122-2

Hamilton, E., Guckian, M., & De Young, R. (2018). Living well and living green: participant conceptualizations of green citizenship. In *Handbook of Sustainability and Social Science Research* (pp. 315–334). Springer International Publishing. doi.org/10.1007/978-3-31967122-2

Hanselman, J. (2018, Dec. 1). Food to fuel — It is not as easy as it seems! *Waste Advantage Magazine*. Retrieved from https://wasteadvantagemag.com

Hird, M. J., Lougheed, S., Rowe, R. K., & Kuyvenhoven, C. (2014). Making waste management public (or falling back to sleep). *Social Studies of Science*, 44(3), 441–465. doi.org/10.1177/0306312713518835

Holst, A. (2014). Clean water act (CWA). In *Encyclopedia Britannica*. Retrieved from http://www. academic-eb-com

Hoornweg, D., Bhada-Tata, P., & Kennedy, C. (2014). Peak waste: When is it likely to occur? *Journal of Industrial Ecology*, 19(1), 117–128. doi.org/10.1111/jiec.12165

Humes, E. (2013). *Garbology: Our dirty love affair with trash*. New York, NY: Avery.

Humphrey, C., Bord, R., Hammond, M., & Mann, S. (1977). Attitudes and conditions for cooperation in a paper recycling program. *Environment and Behavior,* 9(1), (pp. 107-124).

Hunsaker-Clark, C. (2012). Solid waste disposal act. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 840-841). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n323

Ives, M. (2019, June 7). Recyclers cringe as southeast Asia says it's sick of the West's trash. *The New York Times*. Retrieved from https://www.nytimes.com

Jambeck, J., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., … Lavender Law, K. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768-772. doi.org/10.1017/CBO9781107415386.010

Kaiser, F. G. (1998). A general measure of ecological behavior. *Journal of Applied Social Psychology*, 28(5), 395–422. doi.org/10.1111/j.1559-1816.1998.tb01712.x

Kearney, A. R. (2015). A tool for knowing "where they're at". In Kaplan, R., & Basu, A. (Ed.)., *Fostering reasonableness: Supportive environments for bringing out our best* (pp. 273-293) Ann Arbor, MI: Maize Books.

Kearney, A. R., & Bradley, G. (1998). Human dimensions of forest management: an empirical study of stakeholder perspectives. *Urban Ecosystems*, 2(1), 5–16. doi.org/10.1023/A:1009564812609

Kearney, A. R., Bradley, G., Kaplan, R., & Kaplan, S. (1999). Stakeholder perspectives on appropriate forest management. *Forest Science,* 45(1), 62–73.

Kearney, A. R., & Kaplan, S. (1997). Toward a methodology for the measurement of knowledge structures of ordinary people. *Environment and Behavior*, 29(5), 579–617. doi.org/10.1177/0013916597295001

Kessler, M., & Engel, P. (2019, March). A steady path forward. *Resource Recycling*, 38(3), 24-30.

Larson, L. R., Stedman, R. C., Cooper, C. B., & Decker, D. J. (2015). Understanding the multi-dimensional structure of pro-environmental behavior. *Journal of Environmental Psychology*, 43, 112–124. doi.org/10.1016/j.jenvp.2015.06.004

Leahy, S. (2018, May 18). How people make only a jar of trash a year. *National Geographic*. Retrieved from https://news.nationalgeographic.com

Leif, D. (2017, November 28). Heavy lifting. *Resource Recycling*. Retrieved from https://resource-recycling.com/recycling/2017/11/28/heavy-lifting/#example

Leif, D. (2019a, January). Study: Recyclable packaging not always greenest option. *Resource Recycling*, 38(1), 10.

Leif, D. (2019b, April 10). Two states lower barriers for plastics conversion. *Resource Recycling*. Retrieved from: https://resource-recycling.com/plastics/2019/04/10/two-states-lower-barriers-for-plastics-conversion/

Leonard, A. (2010). *The story of stuff: how our obsession with stuff is trashing the planet, our communities, and our health--And a vision for change*. New York, NY: Free Press.

Li, R. (2019, January 9). Does Berkeley, California's foodware ordinance provide a new national model? *Waste Dive*. Retrieved from https://www.wastedive.com

Liboiron, M. (2013). *Redefining pollution: Plastics in the wild* (Doctoral dissertation, New York University). Retrieved from ProQuest Dissertations & Theses Global (Order No. 3553962)

Liboiron, M. (2014, February 10). Solutions to waste and the problem of scalar mismatches [Web log post]. Retrieved from: https://discardstudies.com/2014/02/10/solutions-to-waste-and-the-problem-of-scalar-mismatches/

Liboiron, M. (2017, September 11). Toxins or toxicants? Why the difference matters [Web log post]. Retrieved from https://discardstudies.com/2017/09/11/toxins-or-toxicants-why-the-difference-matters/

Liboiron, M. (2018a, September 1). The what and the why of discard studies [Web log post]. Retrieved from https://discardstudies.com/2018/09/01/the-what-and-the-why-of-discard-studies/

Liboiron, M. (2018b, November 1). Waste colonialism [Web log post]. Retrieved from https://discardstudies.com/2018/11/01/waste-colonialism/

Liu, G., Hao, Y., Dong, L., Yang, Z., Zhang, Y., & Ulgiati, S. (2017). An emergy-LCA analysis of municipal solid waste management. Resources, Conservation and Recycling, 120, 131-143. doi.org/10.1016/j.resconrec.2016.12.003

Loki, R. (2016, July 15). America is a wasteland: The U.S. produces a shocking amount of garbage. *Salon*. Retrieved from https://www.salon.com/

MacBride, S. (2012a). Industrial waste. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 429-435). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n169

Macbride, S. (2012b). *Recycling reconsidered: The present failure and future promise of environmental action in the United States*. Cambridge, MA: MIT Press.

MacBride, S. (2013, December 6). San Francisco's famous 80% waste diversion rate: Anatomy of an exemplar [Web log post]. Retrieved from http://discardstudies.com/2013/12/06/san-franciscos-famous-80-waste-diversion-rate-anatomy-of-an-exemplar/

Massen, S. (2012). Sanitation engineering. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 778-781). Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781452218526.n297

Mcconville, J. (2019, February 10). Socio-technical system analysis. Retrieved from https://www.slu.se/en/departments/energy-technology/research/environmental-engineering/socioteknisk-systemanalys/

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things.* New York, NY: North Point Press.

McSweeney, J. (2019, January). Imperfect inputs. *Resource Recycling*, 38(1), 20-24.

Melosi, M. (2005). *Garbage in the cities: Refuse, reform, and the environment* (Rev. ed). Pittsburgh, PA: University of Pittsburgh Press.

Melosi, M. (2008). *The sanitary city: Environmental services in urban America from colonial times to the present* (Abridged ed.). Pittsburgh, PA: University of Pittsburgh Press.

Miller, C. (2017, February 21). Four trends determining what's next for the ever-evolving ton. *Waste360*. Retrieved from https://www.waste360.com/

Miller, C. (2019, April 19). EPR: Curbside recycling's magic bullet? *Waste360*. Retrieved from https://www.waste360.com/legislation-regulation/epr-curbside-recycling-s-magic-bullet

Moore, B., & Engel, P. (2016, September 10). Percentage pointers. *Resource Recycling*, Retrieved from https://resource-recycling.com/recycling/2016/09/10/percentage-pointers/

Moore, C. (2017). Plastic pollution. In *Encyclopedia Britannica*. Retrieved from http://www. academic-eb-com

Nagle, R. (2012). Politics of waste. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 678-684). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n259

Nathanson, J. (2015). Land pollution. In *Encyclopedia Britannica* Retrieved from http://www. academic-eb-com

Nathanson, J. (2017). Solid-waste management. In *Encyclopedia Britannica*. Retrieved from http://www. academic-eb-com

Nestor, M. (2019). Paying for material recovery: What's in your wallet? *Waste360*. Retrieved from https://www.waste360.com/

New York State Department of Environmental Conservation. (2010). *Beyond waste: A sustainable materials management strategy for New York state*. Retrieved from https://www.dec.ny.gov/chemical/41831.html

New York State Department of Environmental Conservation. (n.d). *Solid waste management (SWM) planning*. Retrieved from https://www.dec.ny.gov/chemical/47861.html

Newhouse, S. (2018, November 28). Rising costs push Philly recycling to back burner – literally. *Metro US*. Retrieved from https://www.metro.us/

Nikolova, L. (2012). Miasma theory of disease. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1,

pp. 540-541). Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781452218526.n208

Nzeadibe, T. & Madu, I. (2012). Open dump. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 632-633). Thousand Oaks, CA: SAGE Publications, Inc. doi:10.4135/9781452218526.n242

Osbaldiston, R., & Schott, J. P. (2012). Environmental sustainability and behavioral science: Meta-analysis of proenvironmental behavior experiments. *Environment and Behavior*, 44(2), 257–299. doi.org/10.1177/0013916511402673

Oskamp, S., Harrington, M., Edwards, T., Sherwood, D., Okuda, S., & Swanson, D. (1991). Factors influencing household recycling behavior. *Environment & Behavior*, 23(4), 494-519.

Paben, J. (2017, February 21). China announces 'sword' crackdown on illegal recyclable material imports. *Resource Recycling*. Retrieved from https://resource-recycling.com/recycling/2017/02/21/china-announces-sword-crackdown-illegal-recyclable-material-imports/

Peattie, K. J. (2010). Green consumption: Behavior and norms. *Annual Review of Environment and Resources*, 35, 195–228. doi.org/10.1146/annurev-environ-032609-094328

Peters, A. (2019, April 4). All the ways recycling is broken — and how to fix them. *Fast Company*. Retrieved from https://www.fastcompany.com/90321566/all-the-ways-recycling-is-broken-and-how-to-fix-them

Product Stewardship Institute. (2019, July). *State of U.S. EPR laws*. Retrieved from http://www.productstewardship.us/?State_EPR_Laws_Map

Reno, J. (2012). Methane. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 532-534). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n205

Rittel, H. W. J., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4(2), 155–169.

Rogers, H. (2006). *Gone tomorrow: The hidden life of garbage*. New York, NY: The New Press.

Rosengren, C. (2016, December 13). California city finds loophole in statewide plastic bag ban. Waste Dive. Retrieved from https://www.wastedive.com

Rosengren, C. (2017, October 9). Report: Publicly traded companies now run majority of $70b US waste industry. *Waste Dive.* Retrieved from https://www.wastedive.com

Rosengren, C. (2019, April 1). New York passes statewide organics mandate, plastic bag ban. *Waste Dive.* Retrieved from https://www.wastedive.com

Rosengren, C., & Boteler, C. (2018, January 2). 6 waste industry trends to watch in 2018. *Waste Dive*. Retrieved from https://www.wastedive.com

Roy, A. (2012). Producer responsibility. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 708-709). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n268

Sallis, J., & Owen, N. (2015). Ecological models of health behavior. In K. Glanz, B. Rimer, & K. Viswanath (Eds.), *Health Behavior: Theory, Research, and Practice* (5th ed., pp. 43–64). Hoboken, NJ: Wiley.

Schultz, P. W., Oskamp, S., & Mainieri, T. (1995). Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, 15(2), 105–121. doi.org/10.1016/0272-4944(95)90019-5

Siddiqi, A., & Collins, R. D. (2017). Sociotechnical systems and sustainability: current and future perspectives for inclusive development. *Current Opinion in Environmental Sustainability*, 24, 7–13. doi.org/10.1016/j.cosust.2017.01.006

Staub, C. (2018, November 13). MRF injuries on the rise. *Resource Recycling*. Retrieved from https://resource-recycling.com/recycling/2018/11/13/mrf-injuries-on-the-rise/

Staub, C. (2019a, January 29). Industry-connected deaths remain high in early 2019. *Resource Recycling.* Retrieved from https://resource-recycling.com/recycling/2019/01/29/industry-connected-deaths-remain-high-in-early-2019/

Staub, C. (2019b, March 19). Paper exports grew in 2018, but plastics fell 35 percent. *Resource Recycling*. Retrieved from https://resource-recycling.com/recycling/2019/03/19/paper-exports-grew-in-2018-but-plastics-fell-35-percent/

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology*, 29(3), 309–317. doi.org/10.1016/j.jenvp.2008.10.004

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social Issues*, 56(3), 407–424. doi.org/10.1111/0022-4537.00175

Stern, P. C. (2011). Contributions of psychology to limiting climate change. *The American Psychologist*, 66(4), 303–314. doi.org/10.1037/a0023235

Strasser, S. (1999). *Waste and want: A social history of trash*. New York, NY: Holt Paperbacks.

Swamy, H. M. S., Vyas, A., & Narang, S. (1994). *Urban innovations: Transformation of Surat from plague to second cleanest city in India.* New Delhi, India: All India Institute of Local Self Government

Tauxe, C. (2012). Consumerism. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 151-154). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n64

Thøgersen, J., & Crompton, T. (2009). Simple and painless? The limitations of spillover in environmental campaigning. *Journal of Consumer Policy*, *32*(2), 141–163. https://doi.org/10.1007/s10603-009-9101-1

Truelove, H. B., Carrico, A. R., Weber, E. U., Raimi, K. T., & Vandenbergh, M. P. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change*, 29. doi.org/10.1016/j.gloenvcha.2014.09.004

Trumpeter, K. (2012). Coal ash. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 132-133). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n55

United Church of Christ, Commission for Racial Justice. (1987). *Toxic wastes and race in the United States: A national report on the racial and social economic characteristics of communities of hazardous waste sites*. New York, NY: United Church of Christ

U.S. Environmental Protection Agency. (2009). *Sustainable materials management: The road ahead* (Report No. EPA530-R-09-009). Retrieved from https://www.epa.gov/smm/sustainable-materials-management-road-ahead

U.S. Environmental Protection Agency. (2014). *RCRA's critical mission & the path forward* (Report No. EPA530-R-14-002). Retrieved from https://www.epa.gov/rcra/resource-conservation-and-recovery-act-critical-mission-path-forward

U.S. Environmental Protection Agency. (2016). *Advancing sustainable materials management: 2014 fact sheet* (Report No. EPA530-R-17-01). Retrieved from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management

U.S. Environmental Protection Agency. (2018a). *Advancing sustainable materials management: 2015 fact sheet* (Report No. EPA530-F-18-004). Retrieved from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management

U.S. Environmental Protection Agency. (2018b). *Inventory of U.S. greenhouse gas emissions and sinks, 1990-2016* (Report No. EPA430-R-18-003). Retrieved from https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016

U.S. Environmental Protection Agency. (n.d.a). *History of the resource conservation and recovery act (RCRA) overview*. Retrieved from https://www.epa.gov/rcra/history-resource-conservation-and-recovery-act-rcra

U.S. Environmental Protection Agency. (n.d.b). *Resource conservation and recovery act (RCRA) overview*. Retrieved from https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-overview

U.S. Environmental Protection Agency. (n.d.c). *Sustainable materials management: Non-hazardous Materials and Waste Management Hierarchy*. Retrieved from https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy

U.S. Department of Labor, Bureau of Labor Statistics. (2018a). *Chart 18. Civilian occupations with high fatal work injury rates, 2017* [Chart]. Retrieved from https://www.bls.gov/iif/oshwc/cfoi/cfoi-chart-data-2017.htm#BLStable_18

U.S. Department of Labor, Bureau of Labor Statistics. (2018b). *Table SNR1. Highest incidence rates of total nonfatal occupational injury and illness cases, 2017* [Table]. Retrieved from https://www.bls.gov/web/osh.supp.toc.htm

Varotto, A., & Spagnolli, A. (2017). Psychological strategies to promote household recycling. A systematic review with meta-analysis of validated field interventions. *Journal of Environmental Psychology*, 51, 168–188. doi.org/10.1016/j.jenvp.2017.03.011

Vendries, J., Hawkins, T. R., Hottle, T., Mosley, J., Allaway, D., Canepa, P., … Mistry, M. (2018). *The significance of environmental attributes as indicators of the life cycle environmental impacts of packaging and food service ware*. Retrieved from the State of Oregon Department of Environmental Quality: https://www.oregon.gov/deq/FilterDocs/MaterialAttributes.pdf

Vergara, S. (2012). Incinerators. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 412-414). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n163

Waste Business Journal. (2017, October 4) *The US waste industry reaches $70 billion*. Retrieved from https://www.wasteinfo.com/cgi-bin/print/printpage.pl?url=news/wbj20171004A.htm

Weber, H. (2012). Landfills, modern. In C. A. Zimring & W. L. Rathje (Eds.), *Encyclopedia of consumption and waste: The social science of garbage* (Vol. 1, pp. 471-474). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781452218526.n184

Wells, N. M. (2005). Our housing, our selves: A longitudinal investigation of low-income women's participatory housing experiences. *Journal of Environmental Psychology*, 25(2), 189–206. doi.org/10.1016/j.jenvp.2005.02.002

Workman, M. (2018, April 25). Wasteexpo 2018: Innovation without consideration. *Waste Today Magazine.* Retrieved from https://www.wastetodaymagazine.com/article/wasteexpo-2018-mrfs-packaging/

Young, J. (2018, August 5). Talking trash: The pros and cons of privatizing waste management. *The Municipal*. Retrieved from http://www.themunicipal.com/2018/08/talking-trash-the-pros-and-cons-of-privatizing-waste-management/

Young, L. (2018a, October 2). A medley of recent industry reports. *Waste360*. Retrieved from https://www.waste360.com

Young, L. (2018b). China: One year on. *Waste360*. Retrieved from https://www.waste360.com

Zeisel, J. (2006). *Inquiry by design*: *Environment / behavior / neuroscience in architecture, interiors, landscape, and planning* (Rev. ed.). New York, NY: W.W. Norton & Company.

Zimring, C. (2017). *Clean and white: A history of environmental racism in the United States*. New York, NY: New York University Press.

Zink, T., & Geyer, R. (2018). Material recycling and the myth of landfill diversion. *Journal of Industrial Ecology*, 00(0). doi.org/10.1111/jiec.12808

APPENDIX A: SURVEY

Stakeholder Perspectives on Waste and Appropriate Waste Management

Survey Response #_____

Part I - Please report the frequency with which you participate in each of these behaviors:

1. **I recycle paper, plastic and metal.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

2. **I conserve water or energy in my home.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

3. **I buy environmentally friendly and/or energy efficient products.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

4. **I make my yard or my land more desirable for wildlife.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

5. **I participate (provide data) in a wildlife study.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

6. **I volunteer to improve wildlife habitat in my community.**

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

7. I talk to others in my community about environmental issues.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

8. I work with others to address an environmental problem or issue.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

9. I participate as an active member in a local environmental group.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

10. I have voted to support a policy/regulation that affects the local environment.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

11. I have signed a petition about an environmental issue.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

12. I have donated money to support local environmental protection.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

13. I have written a letter in response to an environmental issue.

Never (1)	Rarely (2)	Occasionally (3)	Often (4)	Very Often (5)
☐	☐	☐	☐	☐

Part II – Please answer these demographic questions:

14. What is your age (in years) ?

- ☐ 18 – 24
- ☐ 24 – 34
- ☐ 35 – 44
- ☐ 45 – 54
- ☐ 55 – 64
- ☐ 65 – 74
- ☐ > 75
- ☐ Prefer not to answer

15. What is your job title?

16. How long have you been working in a field related to waste and waste management?

17. Highest level of education completed?

- ☐ No schooling
- ☐ Some high school, no diploma
- ☐ High school or diploma equivalent
- ☐ Some college credits, no degree
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Graduate degree
- ☐ Trade/technical/vocational training
- ☐ Prefer not to answer

18. Gender

- ☐ Female
- ☐ Male
- ☐ Prefer not to answer

APPENDIX B: STUDY SCRIPT

[Phase I: Conceptual Content Cognitive Mapping]

We are going to start with a card sorting/sticky note activity.
I'd like you to think about your own perspective on 'good waste management'. Now, I'd like you to imagine you will be explaining your perspective to a someone who is unfamiliar with waste management issues or concepts. **What are some of the things, concepts, or ideas you would talk about? What would be important to consider or address in practicing good waste management?**

Please write down each item, concept, or idea you think of on a separate note. We have a board that you can put all the stickie notes on. Don't feel like you have to use up the whole space, but if you do we have more boards.

[Participant writes down each word on a separate note card.]
[Continue process until participant feels the question has been adequately answered.]

Now please look over the collection of items you've just written down. What items belong together? **Please arrange the items that belong together or in groupings that make sense to you.**

If you think of additional items as you organize your groupings, you can still create new items.

Now think about how you might label each of these groups. Please add a label to each group or cluster you've created. Let's use blue colored notecards so we can distinguish "labels" and "items".
[Continue process until participant feels the groups have been adequately labeled.]

Now I'm going to ask you to explain and elaborate on your groupings and labels. Can you tell me how this represents your thoughts about good waste management?

[Phase II: Paper Survey]

Now I'd like you to complete a paper survey. The survey includes 13 questions about behaviors followed by some basic demographic information.

For the behavior questions, please indicate how often you engage in each behavior, using the 1-5 scale where 1= Never, 2=Rarely, 3=Occasionally, 4=Often, 5=Very Often. Is that clear?

[Phase III: Open-Ended Interview Questions]

Lastly, I am going ask you a few questions on waste and waste management.

(Q1) First, what does "waste" represent to you?

- Is there a difference between the terms like "waste" and other terms like "rubbish" or "garbage" to you? Or are they interchangeable?

(Q2) Second, what does "waste management" represent to you?

- This could be on any scale (ex. Individual, institutional, societal)?

(Q3) Who are the stakeholders, or key constituents, in this/these system(s) you just described?

(Q4) What are the key challenges for this/these system(s)?

(Thank participant for answers and participation in survey)

APPENDIX C: 3CM CODEBOOK

Group Labels
97 Quotations:
WASTE EDUCATION
RECYCLING
WASTE - TRASH, ETC
SOCIAL IMPACTS
ECONOMIC IMPACTS
ENVIRONMENTAL IMPACTS
VALUING RESOURCES/BEING RESOURCEFUL
CURRENT PRACTICES
POLICY
MANAGEMENT OF END OF LIFE
USE/CONSUMPTION
INDUSTRY
COMMUNICATIONS
OPERATIONS
ORGANIZATION/STRUCTURE
EDUCATE
RECYCLE
REDUCE WASTE
REDUCE TOXICITY
PARTNERSHIPS
POLICY
PERSONAL RESPONSIBILITY
BUSINESSES
EDUCATION
FUNDING
PARTNERS
POLICY
ITEMS/PROGRAMS
ECONOMICS
PUBLIC/RESIDENTS
COMMUNICATION
CONSUMERS
REGULATION
MANUFACTURING
END SITES

PRODUCT KNOWLEDGE
GOOD RELATIONS
THE PEOPLE WHO GET IT DONE
NEEDS ASSESSMENT FOR PROGRAMS
RESPONSIBILITY
RESIDENTIAL NEEDS
SOLUTIONS
$ OR RESOURCES TO SUPPORT THE MANAGEMENT
IMPACT OF WASTE
SETTING POLICIES & ENFORCING
CONSUMERS
CREATORS OF WASTE
END DESTINATION OF WASTES
GOVERNMENTAL RESPONSIBILITIES
PHYSICAL SET-UP
INDIVIDUAL RESPONSIBILITIES
INDEPENDENT BUSINESS OPPORTUNITIES
MULTIPLE LEVELS
EDUCATION / OUTREACH PUBLIC
INFRASTRUCTURE NEEDS FOR RESPONSIBLE WASTE MANAGEMENT
RECYCLING / WASTE DIVERSION
PEOPLE
“INTERNAL” PSYCHOLOGY THINKING
RESOURCES + BACKGROUND
STRATEGIC PROCESSES
GOALS / OBJECTIVES
HIGH LEVEL DRIVERS
STEP 1 – DON’T THROW IT AWAY EVALUATE WHATEVER IT MAY HAVE VALUE TO ANOTHER USER
STEP 2 – FIND APPROPRIATE PLACE FOR ITEMS
CULTURAL DECISION MAKING
HISTORICE PRACTICE
ECONOMIC DRIVERS
CULTURAL OBJECTIVE
RESPECT OF PHYSICAL ENVIRONMENT
AWARENESS OF STUFF YOU USE
UNDERSTANDING & AWARENESS OF PRODUCT
RECYCLING
WASTE REDUCTION

PRODUCT STEWARDSHIP
ENERGY FROM WASTE
EDUCATION
POLICY & REGULATION
KEY CONCEPTS
FUTURE NEEDS
HISTORICAL PERSPECTIVE
MATERIALS
BUSINESS MODEL / CRITICAL PIECE OF PUZZLE | CONNECTOR BETWEEN EDUCATION à REUSE OF MATERIAL
BEHAVIORAL CHANGE
“ALL POLITICS IS LOCAL” -TIP O’NEAL
#5 WE DEVELOP OR DISTRIBUTE REUSABLE PRODUCTS
ZERO WASTE
GLASS RECYCLING IS VIABLE NOT COST EFFECTIVE
DESIGN/TECHNOLOGY LIMITATIONS
SOLID WASTE IS ALL ABOUT MONEY $$$
FUNDING $$$
RECYCLING ? WHAT IS THAT?
WASTE REDUCTION
MY JOB TITLE:
REGULATORY
LOCAL LEGISLATIVE / PUBLIC PRIORITIES / OBJECTIVES
FINANCIAL PRIORITIES
BULKY RIGIDS PLASTICS TOYS, BUCKETS, BUMPERS
Miscellaneous
20 Quotations:
how much waste do you produce?
consumer | $/rented (diagram)
e-waste
pushing the envelope
household items
focus on historic
aesthetics
historic interest – what is unique about it
historic interest – who else values it
decision – based
cost-new
cost-old

historically equal waste management
all technology is derived from combustion
plastic is good & bad
stop following trends & make your own sensible path (elected officials)
deputy director landfill / solid waste
-what do we want to do?
can we collect or recover it?
can be done
Advocacy (Importance of)
2 Quotations:
advocacy low investment high return
advocacy
Behaviors - Compost
5 Quotations:
compost yard waste
do backyard composting
compost food scraps by going to drop spots
compost food scraps
- composting
Behaviors - Conscience Consumerism
7 Quotations:
buy less toxic products
only buy what you need
buy reusable shopping bags
conscious consumerism
purchase waste that can be recycled
buy stuff made with recycled materials
-opting for eco-friendly products
Behaviors - Donate
4 Quotations:
donate excess food for hungry people
donate reusable items
donate surplus food
donate
Behaviors - Proenvironmental Behavior
3 Quotations:
check other ways to reduce waste by visiting county website
bring household hazardous waste to the depot
three R’s

Behaviors - Recycling
4 Quotations:
do you recycle?
recycle at the curb
recycle additional items at the recycle center
recycle [participant noted item belonged in both categories]
Best Practices
4 Quotations:
employee retention
safety
bmps – processing [Best Management Practices]
bmps - collection [Best Management Practices]
Best Practices - Networking
2 Quotations:
networking with solid waste professionals → new ideas
sharing of best practices
Best Practices - Professional Development
2 Quotations:
training
professional development
Collaboration (Importance of)
2 Quotations:
mutually beneficial
collaboration w/ colleagues
Communication
3 Quotations:
communication
communication to public, stakeholders
communications – multi-platform
Communication - Outreach
7 Quotations:
levels of engagement
outreach/education
continuous engagement
meet audience where they are
responding to calls/emails
outreach on multiple levels, government, school, organizations
engage on multiple levels, government, school, organizations
Community (Importance of)

6 Quotations:
community exchange
community based
buying from citizens
community participation and “buy-in”
local boots on the ground
local representation in order to create sustainable change
Convenience
2 Quotations:
making it convenient
ease of participation
Cost Effectiveness
2 Quotations:
cost effective
cost-effectiveness
Costs
3 Quotations:
cost of waste disposal
cost of recovery
cost of disposal of waste (recycling, organics, msw) [Municipal Solid Waste]
Cradle to Cradle
3 Quotations:
broken back down into basic materials
circular economy
cradle-to-cradle
Design - End of Life
4 Quotations:
product that can disassemble easily
manufacturer involvement in eol material management [end of life]
if we don’t have a recycle path, invent it
end of life disposal/recycling | -what does it cost?
Design - Environmental
3 Quotations:
clear bin choice trash with recycle bin
containers / receptacles
#2) manage landfills based on design and environmental + legislative goals
Design - Packaging
3 Quotations:
standardize recycling labels

packaging - design -
-how much does it cost to package | -transport + distribute
Design - Product
4 Quotations:
no planned obsolescence (diagram)
designs of products to be recyclable
#product development
initial cost to design & manufacture an item | -how cheap can it be made?
Design - Signage
2 Quotations:
clear signage
clear + concise messaging, not confusing
Economies
2 Quotations:
local economics
economic system
Education
16 Quotations:
waste hierarchy (diagram)
educate friends & family to reduce waste
teach children how to reduce waste
education
food recovery hierarchy (EPA)
educate the public
educate all parties involved
education
educate
educating public
educate people to understand sustainability
education is necessary for many decision makers & elected officials (1)
ultimate goal education #4
education
-cost of educations for waste product
what is the education price
Education - Public Awareness
3 Quotations:
awareness of true costs of programs
public awareness
public education on waste reduction + recycling

Embodied Energy
4 Quotations:
value – embodied energy
existing embodied energy
embodied energy is key
embodied energy needs to be retained
Environment (Importance of)
6 Quotations:
environmentally responsible
environment
environmental protection
sustainability
destruction of environment
climate change is real & directly related to sustainable disciplines
Funding (Need for)
6 Quotations:
funding
funding
$
$
$
-what can we afford to do?
Funding Mechanisms
8 Quotations:
private funding
funding [participant noted that funding fell under both clusters]
funding for waste organization
pay as you throw
revenues from compost
revenues from recyclables
funding & publicity for political + environmental operatives
methane sales to make electric that is part of funding mechanism
vs - reduction + diversion to recycling that is funded by landill $$
Funding Mechanisms - Taxes
3 Quotations:
reduction of taxes reduce waste services
taxes
government funding
Good Intentions

3 Quotations:
good intentions
manage landfill based on actual materials coming to meet design + goals
what do we have to do versus what would be good to do?
Impacts - Economy BAD
2 Quotations:
outsourced
“ “ “ expensive
Impacts - Economy GOOD
5 Quotations:
work force development
economic impact
jobs
fiscal impacts on government/taxpayers
economic development opportunities | analysis: waste→ input
Impacts - Human Health
2 Quotations:
landfill health impacts
health
Leadership
2 Quotations:
leadership
leadership from policymakers
Markets
3 Quotations:
developing markets
recycle commodity markets
can I market it / transport
Markets - Availability
4 Quotations:
recycle markets
availability of end markets
finding commodities
Are the markets sustainable? | -if so, long term?
Markets - Fluctuation
3 Quotations:
changing markets [a]ffecting acceptable items
new recycle guidelines with plastics
market fluctuation/flexibility

Partnerships (importance of)
5 Quotations:
partnerships
private partnerships w/ local businesses
public partnerships
public/private partnerships
public/private partnership
Policy
2 Quotations:
policy development
waste management goals should follow policies regarding walkability & carbon footprint
Policy - Enforcement
4 Quotations:
enforcement
enforcement
permits
requirements
Policy - Incentives
4 Quotations:
incentivize sustainable actions
incentives
incentives
-steering consumer choice
Policy - Legislation
4 Quotations:
legislation
solid waste management plan | SWMP
county legislation
legislation
Policy - Regulation
6 Quotations:
adequate regulation
government laws/policy mandating waste reduction
government rules & regulation
laws
policy & regulations should be based on common sense approach
regulations
Politics
3 Quotations:

politics
political systems
government buy-in (legislative, policy)
Preservation
2 Quotations:
preservation is a waste management discipline
preservation is an old fashioned discipline that is actually a new discipline
Producer Responsibility
6 Quotations:
producer responsibility
at end of life product is returned to manufacturer (diagram)
epr | extended producer responsibility
product stewardship → extended producer responsibility
producer responsibility | business sell products
-manufacturer responsibility
Product Stewardship
2 Quotations:
product stewardship
product stewardship
Psychology
4 Quotations:
how do you feel about recycling?
how do you feel about composting?
psyc [psychology]
various learning styles
Psychology - Behavior Change
3 Quotations:
behavior changes
adapting to change
waste management is a lifestyle
Psychology - Cultural Norms
5 Quotations:
awareness of consumer habits
culture of constant growth
disposable society
modern values speed not quality
“disposable society”
Psychology - Mindset Change
10 Quotations:

enhanced awareness mindset change
paradigm shift required
raising consciousness
shifting cultural norms (understanding dates/labels on food)
more “quality” in older, items made better, of higher quality source material
philosophical shift – new not necessarily better
social value of the work relevant to culture @ large
learning & appreciation of old materials & techniques (craft)
new almost always not better
new not necessarily better
Recycling
4 Quotations:
recycle
recycling
recycle everything
4 – recycling/recovery
Recycling (Challenges of)
4 Quotations:
recycling is very energy intensive
honest: recycling is poor waste management
recycling very high energy consumption
recycling as last resort
Reduction
13 Quotations:
reduce consumption
waste should be avoided
waste prevention
reduce excess from the source
reduce excess from the source
minimize consumption of new materials
reduce the amount purchased
reduce
waste minimization
reduce as much as possible
eliminate as much as possible from waste stream
waste reduction
waste reduction
Repair
3 Quotations:

maintenance & repair
right to repair
reuse/repair rather than replace
Research (importance of)
5 Quotations:
research
scientific information
accurate measurement methods
“evolving Ton”
data gathering and analysis
Resource Management (Importance of)
5 Quotations:
supplies local resources | skills + materials
responsible material management
resources available
resource conservation
mindfulness of finite resources
Responsibility/Accountability
6 Quotations:
shared responsibility
accountability
shared responsibility
accountability
something needs done
-what do we have to do?
Reuse
12 Quotations:
reuse is different from recycling
reuse promotes skill preservation + development
reuse avoids extraction
reuse avoids energy use
emphasis on reuse over recycling.
reuse
reuse
repurpose
monetary value (resale)
sell
re-use
reuse everything

Stakeholders
3 Quotations:
identifying stakeholders
user / owner / consumer | homeowner, institution, business, resident / community member
identify community stakeholders
Stakeholders - Businesses
4 Quotations:
businesses
businesses themselves
insurance industry / construction industry / manufacturers (2)
energy purveyors (3)
Stakeholders - Citizens
2 Quotations:
consumers
homes
Stakeholders - Engineers
2 Quotations:
engineers / engineering
engineering/Engineers
Stakeholders - Government
3 Quotations:
nysdec [New York State Department of Environmental Conservation]
local government
dec / epa
Stakeholders - Haulers
6 Quotations:
transport
competitive haulers
hauler contracts
haulers/business
hauling companies
trucks (collection)
Stakeholders - Institutions
4 Quotations:
institutions
educational organizations
schools
k-12
Stakeholders - Manufacturer

3 Quotations:
manufacturer | valuable product | (diagram)
manufacturer
manufacturers of packaging & products
Stakeholders - Nonprofit
3 Quotations:
nonprofit
non-profit donate sites
reuse centers
Stakeholders - Private WM
2 Quotations:
private sector
businesses that handle wastes
Stakeholders - Staff
5 Quotations:
municipal waste managers | rules vis a vis waste
dedicated staff
custodial staff, proper disposal
environmental educator
manage staff / personnel | -what are their roles + responsibilities
Status Quo BAD
6 Quotations:
current practices are toxic
past waste – less problematic
followed path of least resistance
escalation
all other centuries (until urban renewal) used materials they had, instead of throwing away
purchase price -disposable | -semi-durable | -durable
Technology (Importance of)
5 Quotations:
new technology
other alternative waste technologies
technology will persevere?
can I process it?
can I bale it?
Types of Waste - C&D
4 Quotations:
construction waste
c + d recycling [Construction and Debris]

building deconstruction
building materials
Types of Waste - Food Organics
4 Quotations:
organic wastes
organics
food waste
sorted organics collection #4a
Types of Waste - Industrial
2 Quotations:
manufacturing waste
energy producing waste
WM - Infrastructure (Importance of)
4 Quotations:
needs different infrastructure/mindset
equipment
infrastructure built around waste
biorefinery (33 digesters, 5 vermi-composting, 1 pyrolyze (bio-char)) #6
WM - Marketing
12 Quotations:
marketing materials (â, food scraps) [â = recycling]
social media
tours
culture
events
presentations
website
columns
presentations
events
resource available to share with public
marketing events #1
WM - Programs/Programming (importance of)
7 Quotations:
programs
textile recovery
waste tires
debris management after an event such as flooding, snowing, ice
household hazardous waste

development of programs
appropriate planning
WM - Purchasing
3 Quotations:
public -- purchasing & handling wastes
land acquisition
2 – purchasing
WM - Seperation (Importance of)
8 Quotations:
removing contaminants
identifying acceptable items
if item has one of these values, where does It go?
separating additional items from waste stream
separate collections
collections by color
drop off only model, separated by color
need to be segregated
WM - Services
6 Quotations:
daily operations
troubleshooting
collection
service
actual service recycling | trash
customer service (1)
WM (Conflict of methods) -
3 Quotations:
zero waste versus recycling goals or mandates
landfill vs. recycling
methane vs greenhouse gas avoidance
WM Infrastructure - Compost Facility
3 Quotations:
compost facility
multiple options to compost
compost facilities
WM Infrastructure - Digestion
2 Quotations:
anaerobic digestion
- digestion

WM Infrastructure - Landfill (Need to end)
3 Quotations:
small waste footprint
-reducing/eliminating landfills
figuring out ways to use landfills for other things
WM Infrastructure - Landfills
5 Quotations:
landfills
disposal of final products
landfill
landfill
3 – disposal
WM Infrastructure - MRF
2 Quotations:
recycle MRFs [Material Recovery Facility]
material recovery facility
WM Infrastructure - Recyclers
2 Quotations:
mills
donation spots
WM Infrastructure - Transfer
2 Quotations:
transfer station (S)
transfer stations
WM Infrastructure - WTE
3 Quotations:
wte [Waste To Energy]
capturing landfill gas for reuse
using waste for waste production

APPENDIX D1: TRANSCRIPT OF INTERVIEW Q1 BY STAKEHOLDER GROUP

Q1: What does 'waste' mean to you?	
LG1:	Wow. That's like a super philosophical question. So I guess waste to me represents something that just legitimately has no other purpose, nothing else can be done with it. And I think not just to me personally, but kind on a bit more global perspective or a bigger perspective to be able to say whatever I'm throwing out. I can take a hard look at myself and be like, "There was nothing else I could do with that."
LG2:	Waste? Waste represents more of, partially, a mindset of what we think is wasteful or how we can use something again, or if we can't at all. And also that's kind of constructed, and so not such on a personal level, but also before the individual ever gets to it. It's like a waste that's just a part where you can throw away, I don't know.
INT:	Yeah.
LG2:	Yeah, what is waste to me? Yeah, I think of it like also the physical level where you throw something away, but it's also intangible where you're using something unnecessarily. So either letting the water run too long and have it on hot when it doesn't need to be as hot.
INT:	Sort of like a cultural value sort of thing?
LG2:	Yeah, yeah. Because everything has inherent value or energy put in to create it, first of all. Wherever this post-it note is, now I'm just kind of playing with it and I'm going to throw it away.
INT:	Yeah. So sort of material realities of waste. And then so philosophical or ethical qualities at least, I guess. How that represents humans and what we do.
LG2:	Yeah, it's very moldable as to what is garbage and what isn't. Depending on the person or depending on what they get. But also, you can either group it together, "Oh, that's just all garbage." Which could include candy wrappers and film plastics, and maybe even water bottles and cans. You're like, "Yeah, that's all garbage. We don't need it anymore." However, some of those are at least recoverable to someone—worth enough money to make facilities to actually reprocess them. So it all depends on personal and also society/business—what gives it value.

LG3:	Waste to me is anything that is not wanted and no longer has a use, in general terms. And you can look at it a couple different ways, like are there other opportunities for that and-- but, yes, that's my final answer.
LG4:	The loss of a resource and the loss of money.
LG5:	A lack of awareness.
LG6:	Waste is any material that's not being reused or recycled and is kind of leftover without a greater purpose. Yeah.
LG7:	Wow. What does waste represent? I've never been asked that. That's interesting. Waste is the byproduct of life.
INT:	Yeah. Absolutely, yeah.
LG7:	And it's a constant. It's always there, but I think it's something that we all need to strive to reduce. Yeah, I think it's a byproduct of living [laughter].
LG8:	Well, I guess, more philosophically, waste is the negative, the leftover. So I'm interested in getting rid of the negative or the leftover. So that'd be my appeal to be in this job.
LG9:	I like the definition of waste as an unused resource. I think the problem is sometimes we're not creative enough to use what we consider to be a waste. I was a peace corps volunteer in Malawi where there was really no such thing as waste because everything was used until it would turn into dust. Even shredded plastic bags were used to makes little soccer balls for kids, any clothes are ripped up to make rags. People would use all tires from bicycles to make fences. I mean, everything was repurposed for something else. And that was out of necessity because people just didn't have very much. So when we use the W word, I just think, it's just a lack of interest or creativity in doing something different with it.
CRO1:	Wasteful ways-- what does waste represent to me? I'm not sure how to answer that without using the same word.

INT: That's fine.

CRO1: That it's wasteful or a loss of potential about that. Using whatever it is in a very limited manner when it has a greater value to the culture or society.

CRO2: Well, waste I think is-- I mean, our society is incredibly wasteful. So it's an appropriate name for the moment. It's a combination of both the material waste, but also that mindset of and the systems that are developed that promote wasteful practices. So I think is this kind of holistic thing that needs to be changed.

CRO3: I hate waste. Waste is a problem. It represents a lack of-- well, I would say things that come to mind are a lack of responsibility and a lack of respect, and a disconnect from our either community or earth or natural environment. Yeah.

CRO4: I think waste is an uncaptured resource.

CRO5: Excess. Missed opportunity, slovenliness [laughter], just kind of a general disregard for your environment, but also a necessary part of life. But most, I think most biology, biological entities including the environment itself, have accumulated or developed a way to deal with waste products, right? So waste products to us are not waste products to other beings that are existing because of their-- that's why they exist, right? So, carbon dioxide exists as a waste product, not from us, but plant life absorbs it and uses it for energy. So I think waste to me as a human concept is more about outcomes that we can't utilize to improve ourselves, suppose. You know what I mean?

CRO6: I guess anything that, I guess, people think they don't have a use for. So, to me, in sort of the cycle of waste, there's very few things that can't be reused, I guess. And, I mean, I'm just thinking of my garbage can at home. I'm not a huge producer of garbage. The other day I yelled at myself because I haven't done composting, that kind of stuff. So, I guess, that's for me. That's kind of something at its very, very end of its life cycle. But what I consider waste and what another person might consider waste are very different things. And I find in different communities, it means different things.

CRO7: Carelessness, not taking care of resources, or not recognizing opportunity. Yeah. That's kind of quickly.

CRO8: To me, it's sad. Waste to me is alien to this planet because that's not how our biosphere works. There's no such thing. And so to me, it's a lost opportunity, it's a shirking responsibility, it's a very good representation of how we behave across our culture, we treat people like trash, [redacted] we have a high concentration of putting value on very particular things and valuing a lot of other things. And it hurts us. I mean, where a lot of the modern problems that we have as individuals are because of the way that we are culturally and waste is a product of that.

PW1: I mean, anything that is disposed of. Right? So you've got your biosolids, right, from wastewater treatment facilities, water waste, and then you've got your yard waste, whatever. You've got food waste. I mean, there's just so many different types of waste that we produce every single day. But again, not all of it's waste because it might be being used in a beneficial-use setting. But I think that the normal public would look at it as just anything they throw away.

PW2: You know what? Waste actually makes me sad, just because of-- before I got into this business, which was totally by accident [laughter] but I'm glad that I did. You go to college and you get degrees, and then you don't end up using them in the same field [laughter]. And that's exactly what happened here. But it's definitely opened my eyes to things that I didn't understand, which I think is a positive thing. I'm glad I didn't come into this area with a lot of knowledge, honestly, because it's easier for me to relate to people when I'm trying to educate them. But it does, it makes me sad, just because there's so many things, it's kind of like turning on the news and watching what's going on, with the Trump Administration--you don't really want to watch it, but sometimes you just can't help but watch anyway, even though it makes you sad. That's how I feel about waste. It's a good fight that I'm glad I'm part of and I'm trying to get educated more, myself, so that I can get out there and educate more people as well, and help push them towards zero waste because all I think about is everybody's future and not just my own, but basically the planet's. And when I see stuff like the Green Sword, it's really exciting to me because that's wonderful that China is really trying to stop the pollution and I think more countries should do that, and maybe if we did that, it would-- because now, there's going to have to be more recycle MRFs that are going to have to pop back up in the United States to give more jobs, which hopefully happens. But that doesn't just push for that, but that also pushes for the government to help with this.

INT: Take this as an issue, yeah.

PW2: Yeah, absolutely. So it's not just about global warming, it's about everything, like everybody. So just something small like that, and I think China's huge. I mean, you hear everything about China. You don't hear about India, you know what I mean? And India's huge, too. They want all the shredded paper and everything like that. So it's a sad fight that I hope everybody eventually gets on board before it's too late.

PW3: Waste is what can't be recycled, whether it's in a home environment or a business environment. And there is differences. Some places recycle more than we do, and when I say we, I mean New York State, but it depends on the market and the willingness to do it. There's people that will take mattresses. They'll put them on this big Lazy Susan. You know what that is, right?

INT: Yeah.

PW3: Okay. And they spin them around. And they do it that way so they don't have to handle it only one time to get it up on the table. As it's rotating around, they slice all four sides. They get the material off. The material gets recycled. It goes to some third world country as rags, and they grind it up, and they make new cloth out of it. Then, they get to the inside, and they take the wood, and the wood goes and gets composted. The metal in the springs gets recycled. We don't always do that. There's nobody around here that's willing to do it, and because of that, it goes to landfill just like the plastics right now.

Yeah. Technically, it could be recycled, but there's no market for it right now. Nobody wants it. There's so much out there. And I'm sure if you've been doing your due diligence, you see that they're talking about the oceans because some places are dumping this stuff off barges. It's not good, not good at all, and it's got to stop at the source. So some of the grocery stores now are charging. If you want plastic, they're charging you for it. Some places are taking them back. But I'm sure being a college student, you know exactly what I'm going to tell you. You go to any of these grocery stores, they put your stuff in a plastic bag. By the time you get home, it's ripped. So you can't even reuse it. That's one of the things that is what's waste and what can be recycled, the more the people realize, it's not always that easy.

APPENDIX D2: TRANSCRIPT OF INTERVIEW Q2 BY STAKEHOLDER GROUP

Q2: What does 'waste management' represent to you?	
LG1:	So waste management to me is kind of identifying those sources of perceived waste and kind of trying to educate as to what is actually waste and what isn't. Yeah. Just because something is empty doesn't mean it's waste. Some people we actually, this is like a tangent--But we just gone through the process as a county is rebranding and kind of trying to create an educational campaign around recycling. The marketing firm came to us, one of their ideas was to have a logo that had a waste can, right? And they were going to say, "Waste *can* generate electricity, waste *can* whatever." And I'm like, "I hate that." Because to me, in order to make that successful, they're lumping, recycling and all these other things under the category of waste. And it's like, "That's not how people--" When you tell somebody "waste", they generally think I'm going to throw it out. So was trying to kind of unpackage that a little bit to be able to say, "Okay. These are all the things I produce, right? As a consumer, I produce all of these things. This is recyclable, this is organics." And even if it's like I'm separating out the way I handled brush, I'm making a conscious effort to kind of evaluate my waste stream and ensuring that whatever can go to a responsible secondary use is done that. And kind of as a resident, I think that that's what we want to do is we want to try to help just change the mindset to be able to say, "Just think about it. Think about it before you purchase." So I don't know-- I think that's kind of lumped into that education aspect of that. But what we're learning as we talk to people, is so many people-- for the longest time I've had the three arrows hammered into their head, right? Like reduce, reuse, recycle. And now they're saying, "Well, one of those R's should be refused." So not only are you reducing it, but refuse it, to begin with. And we've seen that kind of lately bear some fruit in terms of like the way people feel about plastic straws. Plastic straws, and plastic cutlery being able to say like, "No. I just don't even need it. I'll put it in the bag or don't put it in my drink. I don't need it." So it kind of goes back around to that social impact on those things in and changing behaviors. So as a resident--when I think about people, that's what I think about responsible waste management or waste management. But I think there's a bigger perspective to waste management too that it's just understanding end products and where end products can be inputs. So as local government, I feel like in some of what we do is try to kind of like connect those pieces where, for instance, we may have a MRF that creates glass through a crusher. The glass is so small – spec— that no mill wants it. But in [redacted] County, we know that we have this burgeoning sandblasting company and that type of material is exactly what they want as like an input to the process. So to be able to say, "Wait, that's a waste to you, but that's their starting product. They need that." So to be able to start building bridges in kind of the stream of consciousness where people start thinking--connecting those dots themselves and start as a county where we have economic

development occurring, just trying to make sure the people in those professions understand like, "Okay. Let's do like these thorough waste analysis so that we can say, 'Is truly waste? Does it have to go here to the landfill or is there other places it can be used?'" And so I think as much as it is, understanding on a household basis, our waste stream and where it goes, also taking a really hard look at us as a county and the businesses that we support and trying to provide them with possible solutions for what they would consider their waste.

[redacted]

LG2: To me, it means a lot because I think it's very important. Everyone deals with waste, so it's one of those issues that brings people together. And then also across all walks of life, up down the social scale, everything like that. It's just kind of a basic need because we have to put it somewhere or else it's going to be everywhere. And yeah, so it has to be managed. We're doing a pretty good job. I think we're-- sorry I'm rambling [laughter].

INT: No, no, no, no. This is good.

LG2: All right [laughter]. I don't know, it's just something that's super important to me, probably because it is important to society, but also often overlooked in its importance because you throw things away--how people just say, "We're throwing this away." And then, it just disappears to them. And then, away is actually a place which I think is super neat which I don't know why, because for me, it was that way. And so it's just away then you uncovered it, and it's like, "Oh, wait, no. Landfills are a thing. MRFS are a thing." And they also have to go somewhere to become something else potentially.

LG3: Whenever I think of waste management, I think more of taking the responsible approach to waste. And then looking beyond-- well, number one, how is it managed in a responsible fashion whether it is disposed of in a engineered facility? Or is there a way to capture that material and reuse it or recycle it, whatever that is, also, again, in a responsibly, environmentally, and economical way.

LG4: Waste and materials management. It is changing the term of "waste" to materials management and changing an ideology that you just threw something away. Because materials management is about a resource. Right? Materials are resources. Waste is just that, spent, unused, lost resources, so…

LG5:	Well, it means taking--looking at what could be discards and finding ways to both minimize what is thrown away and manage what has to be thrown away.
LG6:	Materials management is kind of the bigger picture looking at everything that's generated in an area and the best way to handle it from beginning of life through useful life and then end of life and to kind of extend that life in a way that's socially responsible, cost-effective, and safe.
LG7:	Waste management is trying to reduce the waste. I think that's what it is. The very essence of the environmental and waste management is to reduce it to as small and manageable and mild as possible.
LG8:	Well, besides what I said, I guess it's a way to provide a way for residents to limit, what I said, the negative or the leftover because as human beings, we actually want to have no leftover. We don't want to have to deal with the negative or the leftover. So if residents have a way to deal with it, that actually could benefit or at least not harm the environment, that would be my goal.
LG9:	I guess to me, it means taking the time and using the resources needed to handle materials that people don't want anymore. I hope that we can reduce that material as much as possible, but it hasn't been going in that direction.
CRO1:	Feeding materials back into production or culture, society, whatever, whether it's food scraps turning into compost or cardboard being turned into toilet paper. Whatever it is, it's taking what is waste from one aspect of productivity and using it as the valuable resource for some other product.
CRO2:	Yeah. I think people generally assume it has to do with just managing the materials. And they're the ones we pay taxes to. They take care of everything. So it makes it go to that away place. That we talk about that there is no away. But it's still here in [redacted] county very abstract because all of our trash gets trucked 40-plus miles away. We never have to see it or smell it. And our recycling goes even further around the globe. So that's all going to change.

CRO3: Yeah. It's why we exist as an organization is because there is an excess of food, and so to prevent that from being wasted, and make sure that it gets to people instead of thrown away.

CRO4: An opportunity.

CRO5: To me, it's a job title. To me, it's a job description. And I think it denotes a necessary job in our culture globally of a group of people or a mindset of people that have been designated to deal with the waste that we don't use effectively. Like an ant farm, there are certain ants who deal with garbage, right, and they put it off in a special little place where that's where the garbage goes, right? Fortunately, for ants, that is a biological waste, not necessarily a plastic or anything like that.

CRO6: Well, that's, I mean, the recycling piece of it. The trading of goods. I do think that the internet, actually, and some of the social media world has really taken up the mantle of people can resell to each other. Even if it's for a little bit of money, it's a way for people to make money so they start using those avenues. So everything isn't getting thrown away. Even though-- actually, I've gone to the dump quite a few times in the [redacted] and there's a lot of waste. I wanted to go back into the dump and take the stuff. I'm, "That's a perfectly usable coffee table."

So waste management is being done okay. I think it's a hard discipline for municipalities and localities because I think they have a duty to keep it clean. But I think the way that we do it is a little bit silly. I could go on for hours. In suburbia, they consider all the leaves waste and all that stuff and people spend an exorbitant amount of energy, both their personal energy and electricity, to get the leaves off the lawn. I mean, it is the stupidest thing I've ever seen. You want to move to the country to have land and then you do and then you're always fighting to make it look really manicured and disciplined. To me, that is bizarre and I refuse to spend time doing it. I hate when people take trees down to get the leaves off their lawn. Even my fiance does it sometimes and I'm, "You need to knock it off." The absence of trees is crazy. Building on all of these sites, which is not good waste management. They build, they take off all these vegetation and put these buildings on them and then-- and I definitely, obviously, come from a very development and conservation discipline, but it makes me insane.

INT: Yeah, yeah.

CRO6: And then you don't have good air quality, water quality, and you're just wasted, wasted land, and wasted good stuff.

CRO7: Waste management, thinking about a deliberate process to divert items from the waste streams. Or take advantage of resources. Yeah.

CRO8: Right now, it feels like we're basically just trying to slow it down. So but we're not stopping it, we're not-- in order for it to be really different it comes down to policy. Organizations like us are really important. And I think even if we were able to change policies, I think places like us would still exist and still be in-- it would probably be an even more necessary part of the retail sphere. We're slowing things down, but we're not changing the industry. So I mean, one of the things is that as the financial disparity becomes larger and people are going to be coming to us to try and buy things they couldn't afford but we still have to compete against places like Walmart when people say, "Well, I can just go get this at Walmart for this price." And it's like, "Yeah, you can do that and it's going to be a piece of crap." So and it's going to end up here and in probably about five years. I took some bets after the fidget spinners became really [popular]-- I was like, "How long will it be before we should see one here?" Because there's just fads and VR glasses, the VR goggles. We get tons of those—

INT: You're kidding me.

CRO8: --all the time.

INT: Oh, my gosh

CRO8: Yeah I'd say we get a few a day.

INT: And especially with technology, it's heavily subsidized to get to the consumer as it is. And then it's just bad.

PW1: I would say that waste management represents responsible materials management. Right? It's just making sure that all materials are dealt with in the most effective and efficient manner.

PW2: I think it's an important thing. It really is, yeah. We've been talking about it this whole time. All of these things are part of waste management. Managing your waste, literally, that's what it is, and helping other people know how to manage their waste as well. I think it's an important thing. I love my job. I really love my job. So I don't really know how to express that.

INT: You've been expressing it the whole time.

PW2: I feel like I kind of keep circling the same things over and over like a broken record.

INT: How you frame the Green Sword is really interesting to me because it's like, yeah, now it's an issue again for us. It should be an issue, but you hear that more Americans recycle then vote, right? We all know what it is, but don't appreciate it or don't value it for what it truly is. And so the Green Sword might help companies and organizations within the US truly value it again.

PW2: Yeah, exactly. Exactly. And hopefully they are-- I think, I mean, I know that they're an example for other countries to follow.

APPENDIX D3: TRANSCRIPT OF INTERVIEW Q3 BY STAKEHOLDER GROUP

Q3: Who are the stakeholders in waste management?
LG1: I won't rehash it again, but I feel like-- so it's obviously the consumer, the manufacturer, I think the private sector, and then I believe that local government has a role to play as well. INT: Okay. Okay. And then— LG1: I should just say government because it doesn't necessarily have to be local government.
LG2: Yeah first, I think it's definitely just the individual people, first of all, because they deal with it and then they throw it into either garbage or recycling or whatever, and they're the front lines. Kind of just taking it from this approach, they're the people that decide what bin it goes to initially, which is interesting. So everybody's a stakeholder in that sense. And then onward, outside of that, it's either the institution/the building that they're in, and how they deal with it. So it's wherever the place of the building that you're at, and then just working outwards. Definitely, the towns, and the officials in there, that have to deal with the waste. This is general, who's a stakeholder? INT: Yeah. Right. LG2: Everyone! Everyone's a stakeholder, but I'll spell them out for, yeah-- so you have the town. And then you have all the businesses that are dealing with either hauling or anything like that. Hauling, recycling themselves, all the MRFs. The landfills, and therefore the counties, because they could either get funding through the landfills and the tipping fees and everything like that. So they're definitely helpful-- private landfills too. Businesses are stakeholders. Bottle producers, any producer of a good, they're kind of a stakeholder, but there's starting to be put more pressure, a higher percentage of being a stakeholder, so they're not as-- INT: More culpable sort of, for more what they created. LG2: For sure. Because bottle industry made Keep America Beautiful, so they didn't have to deal with it kind of thing. So they're really creating a different-- which is super interesting. Anyways—so they're a stakeholder. But, on the flipside, you have manufacturers that are producing all of these things that are also-- they want to keep their jobs and everything like that. So they're stakeholders in how we manage and what is acceptable, what materials are accepted and what's not and everything like that.

LG3: So, yeah. And I can repeat myself. I really think every person out there is a stakeholder. Obviously, there is differing people that care very greatly about the environment, and they want to do everything they can possibly do to help the environment. And whether that is not throwing anything away, trying to recycle as much as possible, reuse, reduce their material consumption. But then, you have the other side of it is the people that they are trying to put food on their table, and it's not a concern for them. They have a lot of other more higher priorities. And that's okay. That's going to happen. But, ultimately, they're still throwing something away, and it has to go somewhere in a responsible way. And government gets involved. Whether some are privately held-- all of these, in some fashion, are either privately held, a combination of public-private partnerships, or publicly held. That's it.

LG4: The main stakeholder is-- I view the main stakeholders as the municipality or the public representative, because they aggregate the materials of an individual. So individuals own part of it, but they don't own the main stake in it, because individuals don't always—

INT: They can’t.

LG4: Yeah--think of their neighbor, where the municipality or the public representative or the group represents everybody as a whole and the larger piece of the pie. So everything, I think, and that's what I do with the US Composting Council, is try to get them-- they represent an industry. Right? And composters, public or private, are doing it on the public dollar. Right? So individually, we're the waste generator. The municipality sets or the public representatives set the priorities in the environmental progression. They provide the education and they provide the funding, because at the end of the day, the tax dollar, the taxpayer, the ratepayer pays for that program. Whether it's a public program or a private program, the municipal entities are driving the initiative and that dollar.

LG5: Well, they're quite varied. I think residents and businesses and the colleges and people that are in the business of hauling material or processing material, those that sell products have a lot. landfills. Our facility right here. People who can help you at to basically recycle your food scraps. People that sell compostable materials, there's just so many. Schools--

LG6: Yeah. I wouldn't necessarily say that any are more important than the other, because it's definitely systemic. Recycling wouldn't work if there wasn't individuals who are

recycling, but it also wouldn't work if there wasn't facility operators who were sorting the recyclables, and it wouldn't work if there weren't waste haulers moving it, and—

INT: Buyers?

LG6: Yeah, exactly. But I mostly work with residents and businesses and institutions. I don't do as much with waste haulers or facility operators. [Redacted]

INT: Interesting.

LG6: Yeah. Waste operators. And so tell us how you can divert more materials or you can make more money off of them or you can do it in a way that's better than someone else or that you're easier to work with than someone else.

INT: Yeah.

LG6: So they're a stakeholder. Environmental activists and local politicians are big.

LG7: Waste management's interesting because everybody is really a stakeholder at some level because everybody produces waste. But in managing waste, I think, municipal government on the local level is probably the main stakeholder, the regulators - in this case, it's New York State- so regulators, to make sure that that waste is managed in environmentally sound manner. You have the private companies that are obviously looking to profit off waste management. But the people who are going to keep the municipalities and the private sector in line are your regulators and also your local grass roots environmental groups are the main stakeholder. And they ask the questions. They ask important questions and for someone like me, sometimes, it's a nuisance to deal with them, right? But they play a very important role, they ask those important questions, "Well, why are you doing it this way? What are you going to do with this? How're you going to remove that?" And the recyclers themselves, which is still a private industry, I think those are really the five main stakeholders in waste management.

LG8: So I'd say, well, my department—me. And I'd say the county legislature - I haven't talked about them - because I have to get approval from them to do what I do. Then I have local businesses and municipalities and other counties like my partnership with [Redacted] County. And the state, the DEC. I mean even though I would say, for the most part, I have to follow their regulations, but I feel like they are also a partner. And they reach out to me to see if there's anything they can help me with and financial, with grants, the assistance, so that's-- yeah.

LG9: I'll start with the consumers. Yeah. So the consumers, there are the manufacturers or creators of products and wastes associated with those products. There's the governmental agencies tasked with setting policy and enforcing what's done with products and wastes both on a larger level and also on the local level. And then there are the-- where waste goes. I mean, one thing I failed to put on this map is, even if you trace it before the creators of the waste, there are the creators of materials often from other countries. I think I put energy production of waste, but I didn't put energy producers because there's energy required to mine. Oh, maybe that was the other one, is waste associated with mining.

[Redacted]

I think I got everybody. Oh, and then there's also people who study, who have information related to all of this, the scientific community, and then, there are educational organizations related to the scientific community and others. I think that captures it.

CRO1: Well, everyone, as far-- well, I'm sure, as far as the management or who is affected. Everyone is affected by the process of waste management. So, is everyone too broad of a--?

INT: No, it's-- everyone?

CRO1: Everyone. Yeah [laughter].

CRO2: I think that the way we look at consumers and generators of these materials-- and so the people who are designing it, the people who are producing it, the people who are profiting from planned obsolescence. And then, the consumers need education because people-- you're first generation coming out of poverty. You want all that new stuff that you've seen that everybody has. So there's an entitlement. Material wealth is something that people want to strive for. They want brand new sneakers. They want a brand new house. So tear down that old house. And so there's a mindset around all that, that's problematic.

CRO3: Well, from our perspective and our organization's perspective, it's primarily local food businesses. So grocery stores, bakeries, colleges, farmers, food producers or distributors. The reality given the culture we live in is that there's going to be more than is needed. And so our mission is two-fold. It's the reducing food waste and then the food distribution to people who need it. And so the stakeholders are definitely like that group, primarily business institutions. To some degree individuals, because we try

to also work with local community members to be able to reduce, and that's part of the connection with [Redacted]. If there is extra food that's still good, we encourage people to donate it.

[Redacted].

Yeah. So definitely the bulk of the food we deal with is through businesses, but since our role as to try to make sure that good food's not getting wasted, we try to work with people on that. So encouraging people to donate food that they have, if they can connect with their local pantry, that's great. But the benefit of us as an organization is that we're here and available all year round. So if somebody can't connect with their local pantry, then we try to make ourselves available in between. [redacted] started to specifically to make it easier for people who grow their own food, have gardens or belong to a CSA and have extra produce, to be able to make it easy to donate that. And so we advertise that we're available seven days a week. We can answer the phone and coordinate pickups and drop-offs the food. But if you just have a garden or a CSA share, a little bit of food, it doesn't always make sense to drive around town, dropping it off. So [redacted] to have these collections sites all around the county so that you could just go down the street, to your neighbor's house and dropped something off. And then that when possible is shared right within the same community where it was donated and then when needed, it can be brought back here and distributed through our regular distribution. And then also through the colleges at the end of semester we work with, in some ways, is to collect food as people are moving out, foods still good. So from the stakeholder perspective, that's like we're going to the source of the food, trying to collect it while its still good.

And then also working on education so that-- because a big reason why good food is being thrown away is because of a misunderstanding about what dates and labels on food mean. And so, all the things that we're trying to do is shift that because it's so deeply culturally ingrained in us, all of us to think that if it has a date then it means it's not good. So we're working on that level too and trying to just provide information people so that at least they have an understanding of using--trusting your senses and trying to tell us something that's good by smelling it and it. And instead of just what it's labeled in this. But I would say-- so those are like the primary stakeholders. But then given the nature of our work, the other group of stakeholders are also then the whole widespread community of food distribution partners that we have that once that food has collected, rescued, is being distributed to thousands of people every week. And those are people that really benefit from having access to fresh food that would struggle to buy it or access it otherwise.

CRO4: Everybody.

INT: Everybody, okay.

CRO4: And I mean that literally.

INT: Yeah.

CRO4: We all create it. We're all responsible for our part. It's one of the things that we teach kids in the K through 12 system. I've been in school districts that literally have their facilities people walk around during the lunchtime with their barrels and trash on wheels and the kids just throw, from their tables, throw their-- all-- everything into one bucket. And we changed that. And that's not always easy because it's easy for-- the reason why that process was developed was because they didn't want to clean up the messes. And you're dealing with kids. But our approach is if you empower kids and adults through education and behavior change they will not only change their behavior positively but they will also teach each other and hold each other accountable.

CRO5: Everybody.

INT: Everybody.

CRO5: No, to me, I think there are communities where it's working, for sure. But I think those communities are often rural and they're often considered the Third World or something like that where well, no one has an iPhone so it can't be a wonderful place to live or something like that. In my own life, in my in my own house and land we live in a modern culture, so it's hard to avoid things. This morning, my wife said to me, it's like, "Where does all this damn bubble paper come from?" We order things from Amazon, and every single Amazon box comes with - or B&H photo - comes with bubble paper. And so we're just inundated with these boxes of bubble paper that we then send to recycling. But even over a single week-- and I consider myself to be relatively aware of environmental issues and composting and—

INT: Right. You work within, yeah. Yeah, yeah, yeah.

CRO5: Yeah, and I work in the waste stream, as it were. But I think the cultural forces and convenience drives so much of that behavior, right? So it's like, "Well, I can order--" actually, I can't physically. So I do photography a lot, and I literally can't get silver gelatin paper from anywhere in town, right? And so I have to order it from New York City, basically. And so that causes the waste stream to just continue on, right? Or it's price-based, right? Yeah, I could go to Staples and get a digital SD card for twice the price that I could order on Amazon. But I don't because I don't have that much money.

CRO6: Okay. First is the policymakers. Whatever level you're talking about, federal, state, local. A lot of stuff comes down to your local entity, but I mean we have a great problem at the federal level at the moment with understanding how this works even. So the key big policies are sort of crazy, and a lot of stuff that almost everyone I know worked on at some point in their lives is being thrown out the window. But the localities—the elected officials need to stop looking at trends and really think about some common sense approaches. So that's a key stakeholder is really politicians, elected officials, people who are doing the work, your agency heads of your landfill.

[Redacted]

So it's waste management. It's land conservation altogether. So you really need to talk to the people who are actually doing the work because they understand it better than anybody. And that often doesn't get done. And I think that a lot of elected officials like to just make policies over trends and what they're hearing, instead of just taking a really good look at what's going on. Other key stakeholders-- I mean the American public will follow along with whatever you say in some regards. I mean the water bottle thing, the no water bottle thing, the plastic bag thing, although that's been legislated. But how do you make it go back culturally that driving your SUV that gets six miles to the gallon, but you don't use plastic water bottles—and you reuse your bags. You don't recycle anything. You don't compost. You live in a 4,000 square foot house. How do you tell someone that that is not an acceptable way to live?

So a big piece of waste management is sort of the cultural norms. I don't know. I saw a wonderful lecture once where somebody pulled up a bottle and said, "Look, Macy's is even making water bottles now or something. What is this?" And it all goes back to some core beliefs, but we seem to don't have, a lot of people don't.

[Redacted]

And then the energy manufacturers. The people who are-- I mean the energy purveyors I should say, the manufacturers, make it-- let's just go to the vinyl window industry. It's bullshit. I mean it's the biggest piece of bullshit that ever hit the United States. And now our landfills are filled. Our oceans are filled. Our waters are filled with this crap. It doesn't biodegrade. And what do we do? I can't believe somebody hasn't figured out a way to recycle that into water bottles or whatever it is - I'm sure there's poison in it - and to make people understand that that needs to be done or make it economically viable for someone to do it.

Unfortunately, everything here goes back to money. It all traces back to how much money can you make? Who's going to buy it? And I mean half the time that's why regulations-- I mean the whole fracking and all that stuff. If anybody, to me, really believed that they're going to be able to frack safely anywhere and not really care about people-- or care about people, that's the biggest load of you know what. So again, the manufacturers are only going to follow the regulations to the minimum. As far as I'm concerned, they might make a little noise when they get caught doing something, but

they don't really-- the community benefit doesn't add into the equation. And that's where waste management falls in. It's a community benefit, like preservation.

CRO7: Individuals, institutions, businesses, government, non-profits, the community as a whole.

CRO8: Everybody.

INT: Yeah.

CRO8: I mean, like I said, in order for anything of significance to change we need policy to change, so that it really comes down to who we're voting in and what we're demanding in policy. But it's also a cultural change. We're going to have to have a change of values and we have-- those sort of things have to come about with very big paradigm shifts. I mean, prior to World War II it was a cultural value to be frugal. It was considered patriotic to be frugal. It was considered patriotic to repair. And after World War II when we had all this excess manufacturing, we needed to create jobs, there was an effort to make it so that it was considered patriotic to buy. It was considered patriotic to have the newest stuff and that was because of a major cultural paradigm shift, so we're due for one and there's a lot of different circumstances that are going to require that. I think climate change is going to hold our nose to the grindstone. I think we're going to have a lot of pain and loss, but we're going to have to feel that in order to actually do something about it. So the stakeholders are everybody. Of course, I'm sure there's aspects of the industry that I don't understand and that are paying, lobbying, for things to stay the way they are. So they have a stake in keeping the status quo. I'm not exactly sure who those are, but I know that they must exist.

PW1: I mean, it's a chain effect, right, because have you read the book The Story of Stuff?

INT: Yeah.

PW1: I skimmed it.

INT: Mostly. Yeah. Yeah [laughter].

PW1: I didn't read the whole thing either, but I had to do a presentation on it, and there was a few things that just really resonated with me in that was we, as a consumer, we sit there on the TV. We watch TV and it markets to us, so marketing is always saying, "You need to buy this. You're going to feel better if you buy this." And it's just all about eating more and you have to go get this, and you think you're going to feel

better and then a week later, you're like, "Well, why did I even buy that?" Or you forgot that you even bought it. So it's manufacturing, and then it's the marketing department down here. And then it's the consumer, right? The consumer's never held accountable for just buying stuff that's just thrown away all the time. They don't care. We make it easy to buy, which is okay, but then there's no accountability of making sure that it lasts, and I think that's both on the manufacturer and the consumer.

INT: Yeah. Yeah. That's really interesting.

PW1: I heard that, back in the day, water bottles, we never had a problem with them because the manufacturers would talk to the recyclers, right? So there was this communication. And it happens now on the APR, which is Association of Plastic Recyclers, where you have the people that are making the products, and then you have the recycling. So we're all in the same room and we talk and communicate, but that doesn't happen on all fronts, right?

INT: Right.

PW1: And then this is just a side note, for me, as far as there's so much politics in it and that's what frustrates me. So aseptic packaging, which is your milk cartons, so that's pretty much - what is it? - 70% fiber and 30% polypropylene. There's some sort of a coating on it. And it can be recycled, but it's all about how it's collected and processed, right? And most of it never ends up there, but there was this huge force in the backside of it that said, "We're recycling. Go out there. Offer them money." And that's coming from the manufacturer of it like, "Hey, we want our product to be recycled," and they do this whole push. And now it's kind of coming back because there was no market in China. We can't send it over there anymore. There's a new one opening up in South Carolina. Great, but there's only three mills in the United States that's going to take care all of our milk cartons? I don't think so. So it's not really technically recyclable unless it goes to a hydro-pulper and so it's kind of an illusion that I think that the manufacturer or the design team wanted to create to say, "Yeah, it is recyclable"--

INT: Right. And that goes back to the standardizing recycling symbol because even the recycling sign isn't standardized.

PW1: Correct.

PW2: Absolutely. I mean, [redacted] is how they are because of businesses, businesses generating waste. So that's the start of it. You get small businesses, everybody needs to get rid of their waste, everybody. It's just something that everybody has to do. So you can start small like [redacted] and then they grew because they saw a vision of,

"You know what? We can make a lot of money off of waste," which is true. Getting rid of everybody's waste, which then grew into buying little other guys that wanted to either sell or maybe they sold now they're also still working for [redacted] 20 years later, helping run that business that they had started. But also the larger guys like Borg Warner, or any large industrial businesses huge to us that's helped us grow as well because they have so much more waste. And all that waste at once upon a time used to all get buried. And now because they produce so much waste, there are so many different components in there that can be diverted from the landfill, which has helped businesses like us grow even more that we have a [redacted] resource solutions group that strictly handles large accounts like industrial Cargill salt, I mean pretty large like that. So that's diverting all that waste from a landfill, other cardboard, plastic bags even, even the bags that say with Cargill come in with the salt but they're coated on the inside. I don't know, I feel like I'm getting off topic here.

INT: No, no, no.

PW2: I feel like I had a point but then somehow I just lost it. I'm sorry.

INT: Yeah. I mean, I read a lot about anxiety that gets you off of what you're [inaudible], but municipal solid waste in comparison to construction debris and industrial waste. And so it's interesting for me to hear you talk about sort of the more industrial waste and how key those partnerships are.

PW2: They are key because they produce huge.

INT: Yeah.

PW2: I mean, just [redacted] is huge on wanting to divert their waste from the landfills, which is wonderful. And they can lead as an example to other universities. For a business like us since we've had [redacted] for so long, and we've come so far with them in both them educating us, us educating them, that we can use them as examples when we go to other schools and municipalities as, "Look at what [redacted]'s doing, and look how they went from 75 to 35." Those are just making up numbers, I don't know the actual numbers. So then other colleges are like, "Wow, that's amazing. Yeah, we want to get to zero waste as well. Let's see where else we can do it." I mean, even just down to what we would consider ash.

PW3: You already said it. Waste management. Number one in the world. 20-some billion dollar by your corporation. Are you looking for me to tell you who the players are?

INT: No. You can talk generally—you don't have to talk specifically. I guess I meant within what you do.

PW3: In our area here, a lot of our waste goes to two different landfills. It either goes to [redacted] county or it goes to [redacted] county. We don't truck up to—

[Redacted]

And so they dictate with the DEC what we're allowed to truck into their facilities. Whether it's construction debris or municipal solid waste. They also dictate asbestos, tires, waste tires. All those different lines of business goes to those landfills. [Redacted] has a tire chipper. So you can take full loads of tires into them. They chip them up. They use a lot of it for beneficial use at the landfills. There are some schools that use it in fields as underdrain material under football fields. There's things that it can be used for. Some incinerators are able to take waste tire material because their scrubbers are so good that they're just not burning garbage, they're burning tires too to help cut down on stuff being on the side of the road. But literally, there's only a few players that dictate what comes in. And that's the largest landfill in each New York state.

[redacted]

INT: That must be a huge—

PW3: It is. I've been dumping there for many, many, many years. It was a mom-and-pop operation when I first started going there. And now it's big, big money. But they also have put in a cogeneration plant. So all the methane that's coming out of the landfill, they're using in those big generators that they have and they're selling the electricity. And most landfills that are big like that are doing it. So it's a good thing. You don't have to have a windmill to farm in order to get electricity. You just got to suck up the methane and run that in your generators.
[redacted]

APPENDIX D4: TRANSCRIPT OF INTERVIEW Q4 BY STAKEHOLDER GROUP

Q4: What are some of the most important issues facing waste management, today?

LG1: Right. So I think one of the biggest challenges is changing behaviors, right? People are taught from a young age how to do things. And when you're talking about markets that are so flexible or fluctuate, it's really hard to change behaviors. But again, that's why anyone will tell you if you want to change behaviors, you got to start with the kids, right?

They're the most impressionable and most willing to try something new. They're not as averse to change as adults are. So really, for the longest time, they said, "The only way you're going to get somebody to do something is to make it free and easy [laughter]." And well, I believe that that's probably true - I believe because I think I'm one of them - that there are individuals that will be inconvenienced in one of those regards to do what's right. And so I think it is doing those people a disservice to just operate under those two assumptions. So I think that you kind of need to go a little bit further and say, "Well, maybe I'm beating my head against the wall, but let's try to appeal to that other section of people."

So I think that that's a challenge is changing behaviors and understanding that there's economics behind all of this. And for the longest time, waste management has kind of been viewed as a service to be provided. And so people kind of feel a sense of entitlement about that, right? I should be able to roll my bin down to the end of the driveway and put whatever the heck I wanted to it. Either I'm paying for it through my taxes or I'm paying a hauler to pick it up like, "I can put whatever I want in there," to just be what we've seen is—no. generally, there's a cost to doing those types of things, and that it doesn't always make sense to subsidize those things because then you further that belief that—

INT: Oh, yeah. Further reinforce--

LG1: Yeah. You further enforce that norm that no-- yeah. We're going to continue paying for this or subsidizing it because we know it's the right thing to do at some point in time. We need to be able to say, "The consumers need to know it's the right thing to do. And the consumers need to know that there's a cost associated with it." And we see things like that kind of come out in terms of like the tire example I gave earlier. Most people, when they go to get new tires now, don't really flinch at paying 20 bucks to get rid of their old tires because it's kind of easier to do it at that point in time than to figure out what you're going to do with it afterward. So it becomes a standard. “This is the way it is, and I get used to it.” And so the more we kind of-- I don't want to say hide things because it's not the right term, but the more we fail to educate on the true cost of responsible waste management, we kind of do a disservice to our own selves [laughter]

as we start talking about programs that are necessary in funding. So those are some of the biggest challenges.

And when you talk about, from a county perspective, creation of programs, it's always a discussion relative to funding, and so there's a tremendous amount of education and advocacy that has to go on because at the end of the day, it's kind of comes full circle because if you're creating an advocacy to legislatures or senators or supervisors, they're going to have to be able to go back around to their residents and say, "This is partially why your tax bill is going up, and it's the right thing to do." Or on the flipside of that, when we make that decision to say, "We're not going to pay for this anymore because the private sector is providing you that end-market or that opportunity, but now, you're going to have to pay for it [laughter]." So it kind of wraps back around a little bit.

LG2: Yeah. Clear communication has always been difficult, especially now with single stream. And, just in general, I think we're being more environmentally conscious as a whole as a society. In the US we're-- at least what I've been seeing more of personally, is more, "We have to something for the better of the environment." which is great. However, a lot of people are wishful, and what they recycle and everything, so they're just adding more stuff than that should be added to the bin, creating more waste. Although that portion probably isn't being communicated as effectively. Or it's more of it's a newer occurrence, so it's not engrained in who we are and how we think quite yet. But just general communication, what goes where and why, is a huge thing. And managing public perception of just, "Oh, they're throwing it away anyways." kind of thing. That's partially true, partially not, at the same time. Lots of variables there, but that's a struggle.

INT: Yeah. So communication--as that relates to public perception.

LG2: Yeah. Availability of composting, which is an issue I think, because then that effects landfills and lifespan and everything like that. And there was just one major issue of-- right? You were looking for--?

INT: Or yeah, I mean it could be multiple issues.

LG2: Okay. Because it's mostly for me, it's the communication. Well, now, finding new markets, developing markets, recycling markets specifically, so we can pick up the slack from China's ban and everything like that, so--

INT: The National Sword. Everyone, who I've talked to, has essentially brought that up.

LG2: Yeah. You have to because it's been huge, and good on China's part. I mean, if they're in-- it would be bigheaded for me to say, "No. They need to keep accepting this," when it's actually costing human health and environmental health as well,

INT: within China, within--Yeah. Well, not even within China, just the States as well.

LG2: So it's kind of a bummer that we're not recycling because it just makes us feel good maybe, but it's also kind of nice because it puts waste back in the forefront in saying, "Why are we doing this in the first place? Do we need all this stuff?" And then, I think it's also a challenge of getting at the right things to get more people to do the right actions, which is reducing, rather than just relying on recycling. Because, at the moment, it almost equals just putting it in the landfill anyways.

LG3: Yeah. Well, so, there are lots of challenges. I would say, it's people [laughter]. I keep going back to people, but I really think it is. Because if they don't want to do it or they don't know how to do it, it can really impact all these different factors. So that's one big challenge, and that's where education comes into play. But also, right now, a big challenge, well, is money. That's another one, is funding all these things. And a lot of waste management activity started-- well, you could say, in the 70s, 80s, potentially, with a disposal method at that time. And then by late 80s early 90s, the recycling infrastructure started to pick up. And, primarily, in the States, we're talking-- say, New York state. A lot of the infrastructure is old and decaying now because it hasn't been updated.

[Redacted]

Our material recovery facility was built in the 1992ish time frame, and it hasn't had a—it hasn’t been updated. The equipment's been updated to an extent, but it hasn't had this overall new facility, new engineered facility. And we just don't have money to do that. So, of course, if we had better equipment, then we may be able to capture more things. And then, the other thing is recycling commodity markets right now. The impacts of China, the impacts of the global market is a big challenge for all that. Because we put so much effort in trying to divert material away from a disposal method into something else. And the opportunity is very limited in where that material can go. It really upsets the entire system as a whole. So supply and demand gets turned upside down.

LG4: The key challenge is funding and market stability/longevity. Those are the two keys. And they're not going hand-in-hand on the commodity or the resource side. And often they're not going hand-in-hand on the landfill side. As everybody competes, competition sometimes creates false pricing structures, so in some areas, landfill has gotten cheap because they subsidized an industry on something else. We use the landfill or the waste industry to subsidize recycling. When recycling is really good,

sometimes we can use those profits to subsidize the collection industry or for the landfill the private companies that own the landfill and the collection and the-- so they have multiple pieces of the pie to subsidize one arm of the industry.

But that's industry whether it's Carrier making a product or Honeywell or a big player, they're winners and losers. Sometimes you have to make a few losers because there's product demand there but it's not always financially beneficial but it carries your corporate name and people are reliant on the product so you subsidize it with another. The waste industry is the same.

LG6: Yeah. We have a fairly good marketing structure [redacted] the kind of green fence came first years ago, 2008 or '10 or something, maybe less. And so people have kind of been adapting slowly to that. And then, with the Green Sword, a couple of months ago, they decided to move the last bits of recyclables that were going overseas to domestic markets. And so now, everything is marketed domestically, so it's not impacting us. It's not impacting us in the devastating way that it's impacting municipalities on the West Coast, where everything was going to China. So it's going to encourage us to clean up our recycling stream because the market is flooded with recyclables and nowhere to process them or less places to process them, I should say. So that's one thing we're doing. And then, hopefully, there's some legislative and political action and economic action that incentivizes recycling mills and plants in the US so that we can recycle as much as we want to be recycling in a more local manner.

INT: Right. Right. That's interesting. I guess are these buyers that would process the recycling that you aggregate here. And they're mostly domestic at this point, or on the East Coast?

LG6: Mostly domestic. Yeah. Now, they're entirely domestic, mostly on the East Coast. Some of the plastics are going to a couple places in the Midwest right now. Yeah. And the markets can change. If you would ask me a year ago where our paper is going, I could say one thing. And then, you could ask me this year, and it's like, "Oh, a different mill gave us a better price," or maybe mixed paper goes one place and newsprint goes another place and that kind of thing.

INT: It's really dynamic or volatile.

LG6: Yes. Yes.

INT: That reminds me of the individuals or community members and psychological barriers. That's something that's really interesting to me. I can imagine how difficult it is, communicating how volatile and dynamic-- things change, different commodities--

LG6: Yes, "How dare you tell me this isn't recyclable? You told me, seven years ago, that it was recyclable." Yeah. All the time, we went to single-stream recycling in 2008. And so often, we get older people, especially, who are like, "Oh, I've saved up all my plastic

bottle caps for the last 20 years. I hear they're recyclable now." "They're recyclable if you leave them on the container. When you bring them to me, these bags and bags of them, they're too small for the recycling system." And they're heartbroken because they put in all this effort. They thought they were doing the right thing but missed that little piece of information or maybe it didn't-- communicate it on our end. Yeah. Yeah. That's very sad. Or some people who have been throwing away their yogurt containers because years ago, they had heard yogurt containers weren't recyclable. But now, they are. And so then, they feel horrible that they did that. Or sometimes, it creates the psychological barrier because they think, "Well, it changes too much. None of this is true. It's all going in the trash anyway," which is not true. But so they just decide, "I'm not going to put my efforts there," or, "It's not worth my time," or, "I feel like I'm wrong when I'm doing this. And I don't need that." And then, there's the other side, where people recycle as much as they can because it makes them feel really good because they feel they're doing the right thing.

LG7: Absolutely. I can give you two that are of great concern. Food waste, which we talked about, and managing organic waste, and how we're going to handle that on a large scale. We've done pilot programs. We've done pilot composting programs. But to really have a major effect on waste reduction, it's going to be removing food waste from the [inaudible]. So that's the main challenge. In a place like [redacted] or in New York City, even bigger challenge, how are you going to manage that level of organic waste? What are you going to do with it?

The other major challenge I've had is a by-product of the by-product--by-product waste management, things we didn't think about when we built these facilities that handle waste, when we built these facilities 30 years ago. These ancillary effects of handling waste, when you're carting waste and when you're storing it, it produces leachate, and leachate goes into the stormwater system. And in 1980s, we didn't really think about how handling waste, driving it in trucks that leak or putting it in facilities that don't capture the by-product waste, how they affect other environmental systems, and we're thinking about that very much now. And we really need to manage how we manage waste now. There needs to be curbs to prevent waste from affecting the stormwater system, to keep it out of the sanitation system because you don't want the heavy metals that are in waste going in and ruining your waste water treatment plants. So you really have to manage the by-product of waste, manage the ancillary effects. And that's been a big challenge because a lot of these facilities were built in the 80s, 90s, when it wasn’t--it should've been probably but it wasn't as much of a concern.

LG8: Key challenges are funding. So funding. I'd say education and the fact of getting our programs out to the residents, to the public. So having them understand what we do and our new services or changes if there's any changes or-- and--

INT: [inaudible] those are pretty big challenges [laughter].

LG8: Yeah. Those are the biggest ones. But it could also be-- I was talking about with the organic waste. That I just don't have-- I mean it could go on to funding, but I don't have-- one of my biggest partners, I rely heavily on them, which is [redacted] And so I have to take into account, well, how much can I put on them to help me run this program. So I really don't know how I'm going to make organic waste--

INT: Right. If it's not something they're already thinking about or working towards, how much do you have to devote in funds to helping them to do that and—

LG8: Right. Yeah. And then [laughter] it goes back to, "Where am I going to get those funds?"

LG9: I think one huge challenge for human beings is cooperation, especially when it comes to the public's sphere and tragedy of the commons. It's really difficult to get people to take care and reduce waste and really understand what that means. There's sort of a long term arc, which could be, at this point, collapse, collapse of our entire society and systems, and it's kind of where we're heading, and to get people to now make a different choice when that hasn't happened yet is really difficult. It's almost like people have to see the proof before they believe it's going to happen. But by the time you see the proof, it's done. And so I think that that's the story of waste as well as the story of the environment right now sadly. And I think it might just be something that has to do with human beings. And it's just we've haven't evolved to be able to do that.

INT: Preempt, yeah.

LG9: So it's like fighting of impossible battle to get people to understand the impacts of creating all the waste, the impacts of consuming it, the impacts-- yeah, it's really difficult, and yet there are plenty of people who can follow this thread, and they will make different choices. But I think they're a minority right now. Most people are just trapped in their lives, busy. So that's a challenge. See, another challenge is-- I think it was just kind of the way we've structured our lives, and it has to do with a time deficiency.

INT: Yeah, absolutely.

LG9: People are working two jobs or both people are working two jobs, and they're trying to raise a family in isolation. And really the last thing on the list is going to be caring about the greater environment for the future, really, the very last thing. So trying to

convince them to spend a few more minutes to sort recycling from garbage or to walk a food scraps out to the compost is an uphill battle just because of the conditions. And I'm not sure why those conditions exist, but they do. And I think that's just the reality for people so that the opportunity is if you can make things incredibly easy, then you have a chance. So that's what I do.

CRO1: Well, it's a cultural shift from the 'use it and dump it' headset, that mindset that we have unlimited resources and unlimited opportunities to consume, and shifting that to a mindset where the material, whatever the waste is, still has value.

INT: Yes. That's a huge yeah. That's the big one.

CRO1: Right. Right. It's an awareness. It's generating an awareness, a respect, and a willingness to participate.

CRO2: Yeah. Yeah. I think mindset is big. Well, I think capitalism is a factor.

INT: Yeah. Absolutely.

CRO2: It promotes the mindset of, "Every man for himself. Need to get wealthy without thought beyond my own lifetime." And so I think there's major deep-seated problems in the systems that exist. And I also feel optimistic that we can work within systems to make positive changes. And, actually, I think things will inevitably shift because I think resources are going to become more dear. And so companies like Unilever, who are being more thoughtful about that, are going to thrive as they start figuring out better answers-- they're going to be leaders. And they're going to be invested in. And they're going to survive.

CRO3: Well, it's interesting. It's both really simple and there's a lot of moving parts. But our whole thing is to try to keep it as simple as possible. [redacted] So, for the most part, the programs that are distributing the food, which every day of the week is a different one, they're responsible for doing the pickups. So they know. It's Monday. So they know these are the places I have to pick up from on Monday and then, the food goes out. So we don't have trucks and warehouses where food is getting brought back to. It's generally speaking going from [redacted] to the program that's distributing it.

[Redacted]

And we primarily functioned-- loading dock as our general HQ. And food would just go out. So since we've been in here, for the first time, we have the place to accept donations outside of the schedule of distribution, which is super helpful for a lot of the programs we work with that either don't have their own physical space or community organizations that are making food available to clients that they're working with as opposed to open to the public food pantry. So some groups, volunteers, and community programs will just come here to see what's available and maybe they're a caseworker working with a homeless youth or a family that's receiving services.

INT: I see.

CRO3: They'll just pack up some food and take it to the people they're working with.

INT: I see. Interesting.

CRO3: So it's this whole-- really, it comes down to relationships of people in the community who identify what a need is like people that don't have enough to eat and then, we just try to support any efforts that people want to make for bringing food to places that need it.

INT: So a lot of facilitating relationships.

CRO3: Yeah.

INT: Yeah. Interesting.

CRO3: But in terms of challenges, it is a pretty efficient system. And coordination is just the nature of it, so I wouldn't even really consider that a challenge because it's just what happens. But I would say challenges include the education or providing information to people on all levels like household, individual level as well as the business level of what food is still good and then, what can be donated. And so that's probably the biggest hurdle we have. Or even businesses in the community that are hesitant to donate something that's perfectly fine because there is a fear of being sued or they say that they're afraid somebody would get sick. So even though there is a federal law in place to incentivize donation, we still come across challenges with that.

INT: Right.

CRO3: And then, even within our own community-- but certainly the community as a whole, the biggest challenge, probably, is perfectly good food that's getting thrown away because somebody doesn't think that it's safe.

CRO4: We look at-- this is a building project rather than a tearing down project. The current system was put in place and works very effectively because that's what was built. We're just building an alternative system. And I think that the communities that are interested in going down this road, hopefully, that will be everyone ultimately, but they will one at a time head in this direction. Either out of necessity or desire or regulation because they have to.

CRO5: I think the work of waste management is, and this is true of a lot of different jobs and culturally in the world, are looked down on. And this is true with the trades as well. So I'm in the trades, whatever that means. But trades used to be looked at, historically, again, from a historical perspective, as just a very respectable profession or at least a somewhat respectable profession. And that's declined, I think, in the overall viewpoint. And you can see that now there's serious lack of trained carpenters and other tradesmen. And people are doing substandard work because they haven't been trained and they have no other choice. I think the same, if you were to elevate the idea of profession of waste management, and again I'm looking at it from a job description standpoint, you would see the situation improve because you would look at it as a noble pursuit as opposed to something that you have to do, right? Like if you went down and interviewed the guys at the dump, who I see all the time, they probably wouldn't think of themselves as doing something noble. They would probably think of themselves as, "Well, yeah, this job sucks. I just do it because this is how I get paid." And that is why they're doing it. They're not doing it because they think it's important. At least, that's my perception. They're doing it because they have to do a job. And so, doing a job is a whole lot better if you think it's worthwhile than if you think you just have to do it.

This job is difficult at times because it is--we're a nonprofit. And I think there is a-- not that all nonprofits are this way, makes tons of sense. But I think that the nonprofit's on the fringes are looked at as a place where, while it's necessary to support them, but we don't really expect much to come out of it. And so we're underfunded in that way. Most of this place runs mostly on grants and donations. And so we have a limited budget and a limited amount of people we can hire and things like that. And so what ends up happening is we got overwhelmed, right. And so you become-- I think it's like a grind that moves on and on and it's hard to kind of apply-- it's hard to apply new ideas and new strategies when you're constantly playing catch up. And I think, especially from a landfill standard, you're always playing catch up because there's always more garbage.

The challenge is to somehow-- of course, it's the hardest thing you could possibly ask someone to do is you have to somehow enact a culture change. Wherein all of these different pieces will slowly churn and create a new culture, right?

A culture of understanding, of respect, and for both the people doing the work and for the environment itself that we live in. At the end of the day, I remember talking about this with a teacher of mine, environmental conservation is this kind of-- we were both talking about how it's this hilarious concept. It's not really environmental conservation that we're talking about, we're talking about human conservation, being able to survive, right. Or are we going to poison our environment to the point where we just burn up, which is likely outcome, it seems to me at this point. I heard recently in the New York Times or something on the radio, they were talking about this strain of bacteria that they found or virus that would just It grew so rapidly that it toxified its own environment in the petri dish. And I was like, "Well, straight up correlation."

That's basically what's happened is that we are growing so rapidly and we're consuming things so rapidly without regard for growth that will end up poisoning our own situation and take a lot of species with us.

Mountains will rise and fall, volcanoes will blow up, a million years from now, who knows? But I think that idea hasn't really permeated yet. And that's why I think technology has changed, but humans as a species, I think are pretty much the same as we were 100s and 100s of years ago, personally. And I think we've just got these fancy tools that we can use to accelerate things. Right?

So, yeah. I think the challenge is being able to avoid-- personally, I'm not worried about nuclear war, I'm more concerned about staving off, poisoning our environment, I think that's the bigger concern and in the long run, and being able to find balance, right?

CRO6: First of all, the way that people view everything. That's one of the big - that's the question, right - challenges--in preservation is-- what's the word? "Oh, it's deteriorated. It's bad. It's not salvageable." And we're talking perfectly good materials. We're talking a greed that I cannot even begin to understand. I have seen, again, 450 buildings come down. I can tell you that probably one or two percent of that has gone somewhere else to be reused. There's the toxin. Oh, you can talk about the environment. The toxin industry, which is also bullshit if you really examine it carefully. We'll just use asbestos for a minute.

Asbestos in window glazing can be minimal traces. You're not removing it. You're replacing it. If you're suited up, you're doing whatever, that constitutes asbestos being in a building. So when people start to get nutty, like, "Well, we're not going to remove

it because it's dangerous and it's going to cost too much money. So we're just going to take the windows and throw them out." That's also B.S. Everything was made to be repaired, in the old days at least in preservation. So that's a huge challenge. The toxin environment that they've created, not necessarily that the toxin industry actually-- what they're saying exists. The mitigation measures that they've put in place are also B.S. Yes, people have gotten sick. I'm not going to deny that. Myself maybe included, I don't know. But it's really hard to watch it. And rhetoric is the challenge, "It's not usable. It's got a toxin. It's this." And so you're stuck looking at astronomical rehab bills, restoration bills, lack of imagination, lack of creativity, lack of incentives.

Although in New York State, Governor Cuomo - I will give him big props - and the smart growth industry-- I just saw a lecture by them last week. The smart growth agency that 's within the state has done some remarkable things. And especially for the urban core. So the state has a tax credit, a 20% historic preservation tax credit, both for homeowners and for commercial use, and the commercial use couples federal use. So that's a really good thing for reuse that you wouldn't see in a lot of other places, but we're still under the urban renewal idea that you should be able to drive and have a parking lot to get there, and so that all goes into waste management. It's what do you do with the building that's standing in a place you think should be developed? And then, it goes to a landfill. Hopefully, they would give us the salvage to resell at some point, but a lot of stuff ends up going as a waste. So for preservation, the discipline, it's still that way. It's still a problem. People don't understand how-- and again, [inaudible] does it a lot better than a lot of places. You can go from a structure that, yes, had some wear and tear certainly to a new structure, and you can look around and see it being done here. There's a lot of money. It's always about money, unfortunately, so.

CRO7: To get people to embrace this model that we mapped out means enhancing the convenience for that for the user so that they're more willing to take advantage of the opportunities to divert waste and to see it as beneficial to them

INT: Yeah. Yeah. Do you have any specific examples of working on that convenience?

CRO7: Yeah. Taking a truckload of stuff to the dump is easier than sorting those items and finding the right next home for each individual item. So for us as an organization, offering the chance to go out and do that for them. So we'll take our truck, and we will kind of sort through their items in a barn or a garage and say this is appropriate to take to us, this is appropriate to give to a different organization, this truly does not seem to have another life. Doing that type of work with people makes it easier for them. Phones, texting pictures of things. Email, just making communication easier so that they don't have to do as much work.

INT: Yeah. Yeah.

CRO7: And they can understand the value. Because they might just see a pile of junk.

INT: Communication, I didn't think it as being open to any medium I guess.

CRO7: Yes. Whatever makes it easier-- For them. --for someone to understand what we are asking, and for us to understand what they're talking about. Visualizing items is much easier by a text rather than having them try to describe something that they don't really know about.

INT: Right. Oh, yeah.

CRO7: Yeah. So that's just kind of making their job easier, or more enjoyable, or the classic they're getting a tax donation for donating these items. Whether that still exists in this political climate, we'll find out, but things that incentivize finding new homes for things rather than just throwing it away.

CRO8: Yeah. I find an interesting one is I remember-- this is before I even moved here, but there was a big, big backlash about having all these big box stores. These are relatively new. They've only been here about 15 years, something like that, and [Redacted]. And so, when that was being considered there was a lot of backlash and protest, and the mayor at the time was pushing for it because we were losing so much money because college students were going to other towns because they wanted to go to the stores that they knew. And so, we were losing a lot of money and we were losing a lot of jobs and taxes because we didn't have them here and there were all these other benefits that you can get from having these sort of stores here. It's a really, really difficult thing.

[Redacted]

It's the cultural everybody for themselves, individualism, not working together as a collective, not knowing how to think of our identity as not an individual but knowing that our identity is actually a collective. But we're raised to fight for our own individual rights and so, it's so permeated. It makes change really difficult because people don't know how to work together because we're taught to work for ourselves and not anybody else. So we're constantly having these things pitted up against each other. I mean, that's the-- any progressive agenda, that's some of the biggest problems is the individualism. So what's going to change that? Again, there's going to be probably a crisis of some kind. So, yeah.

PW1: Education. 100%.

INT: 100%. Okay.

PW1: The public is confused. They have no idea what any of this is. They see [laughter] "Oh, logo on there, I can recycle it," you know?

INT: Right.

PW1: They want to recycle this, so they throw it in there. And so contamination in the recycling stream has gone up. And again, I'm really just speaking to recycling because if you look at one ton of trash, 60% is recyclable, 30%'s organics, 10%'s true trash, right?

INT: Mm-hmm.

PW1: So the public isn't educated, and they don't care either. All they want is they're going to put it out on their day, or they're going to bring it to their transfer station, and they want it to go away. They never once think about it afterwards. And now maybe it's getting some traction with social media and what not, but the right message isn't getting out there because The New York Times just posted this huge article saying, "These are the top contaminants in there." And two of them were not correct for this region of the United States. So pizza boxes, they said, "You can't put it in there." We accept pizza boxes all day. We accept number five polypropylene yogurt containers all day long. Now, California relied on China to ship most of their stuff, so they have taken it off their list because their local mills and domestic markets don't have that stuff, or they don't have domestic mills that process it. So it's more of a region because it goes back to right here of is it recyclable or not?

INT: Yeah. Region is so important. Yeah.

PW1: So if you're from Hawaii and what the rules were there and now you move to Rhode Island and all your material goes to Rhode Island Resource Recovery, you know?

INT: Yeah. Yeah. Yeah.

PW1: They have way different rules than Hawaii does probably, so that's the biggest problem.

INT: Education.

PW1: Education.

INT: Yeah. And the different just-- I think that's lost on almost-- or the general public, right, that it so matters your local situation more than probably anything, and you have to be aware of that wherever you go

PW1: So when I do give a presentation, I always say, "Okay, what makes something recyclable?" That's the first question I always ask somebody. It's like, "Well, there has to be an end market. There has to be somebody that wants to make it into something else. And we're a capitalistic society, so you need to be able to make some money. You're not going to do it for a loss." Is Styrofoam recyclable? Yeah, but it's very costly because you got light air. You're just transporting it a ton when it should be 20 tons

PW2: Just educating people.

INT: Education, okay.

PW2: Education is the biggest challenge I think honestly. Education and costs, are the huge -- because I can go out and educate all day and everybody can understand what I'm saying. But if nobody wants to spend the money to follow through with diverting trash from the landfills, then it doesn't matter. I mean, it might make a difference. And even though this person doesn't want to spend the money to recycle or compost, he's just going to still junk everything that he comes through. And when we bring it here, it's not like we're going to sort it out. We don't bother recycling down the county, but when we bring stuff back to our transportation, the upper level here is for construction debris, the lower level back there is for trash. And my guys aren't going to go through and pull out the recycling that gets down like the construction debris or whatnot, unfortunately. There are some transfer stations out there that actually have people manning the floors all the times to do that. Which is great. We just can't do that. But maybe with that one person, it might come up in conversation somewhere else where they pass that education along then that person will act on it and see the value in spending the money and do something about it. So education is very important. And then when it falls on us to try to show people a return in their costs, that helps as well. So it's a constant struggle.

INT: Yeah. So it seems like it's education of telling them what to do and how to do it, but it's also shifting the culture, the perceptions of social norms of like, "I shouldn't have to pay for this," or--

PW2: Right, it is.

INT: Right?

PW2: Right.

INT: It's education in that sense.

PW2: And then again, that all falls back to how the Green Sword effect is happening where now it's costing businesses like Casella or Waste Management, Republic, Allied Larger Corporation. I mean, waste management is international, we're just a little New England area, you know. And then you have other like Allied Waste, Republic, they're national as well, who own the recycling MRFs, who own the landfills, who-- it's costing businesses like us more money, which is going to trickle down to the small guys as well on the cost them more money. So here, we're trying to fight with everybody to show them the value in recycling or composting and maybe a return to convince these people to divert their waste. Well, now it's going to cost even more money. I mean, so there's going to be that struggle that's going to happen real soon as well. So I'm not going to be able to go into businesses to be like, "Hey, look at how much money you're going to save." Really, it's going to be like, "Oh, I might end up costing you a little bit more, but look at the impact you're going to have on the environment down the road, and hopefully your predecessors follow you as well." So it's going to be a fine line, it's going to change the way I'm going to have to educate people in the future as well.

PW3: Well, my line for 38 years has always been, "I'm in one of the safest industries," okay? There's always going to be garbage one way or another. If you and I are the last two people on earth… The dynamics of waste may change over the years and it absolutely has. But there's always going to be garbage. There's always going to be something that can't be landfilled. It can't be recycled. It's got to be handled. So as far as I'm concerned, I'm 60 years old, I'd like to work another nine years in this business and I'm sure there's going to be garbage for me.